



INSTRUCTIONS

LOAD TESTING

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INTRODUCTION

This section provides information on load testing the Series-7 diesel-electric locomotives. It is divided into two parts:

1. Self Loading on dynamic braking resistor grids
2. Connected to external loading unit, like 17EM99.

These instructions do not purport to cover all details or variations in equipment nor to provide for every possible contingency to be met in connection with installation, operation or maintenance. Should further information be desired or should particular problems arise which are not covered sufficiently for the purchaser's purposes, the matter should be referred to the General Electric Company.

Verify numbers for parts, tools, or material by using the Renewal Parts or Tool Catalogs, or contact your General Electric representative for assistance. Do not order from this publication.

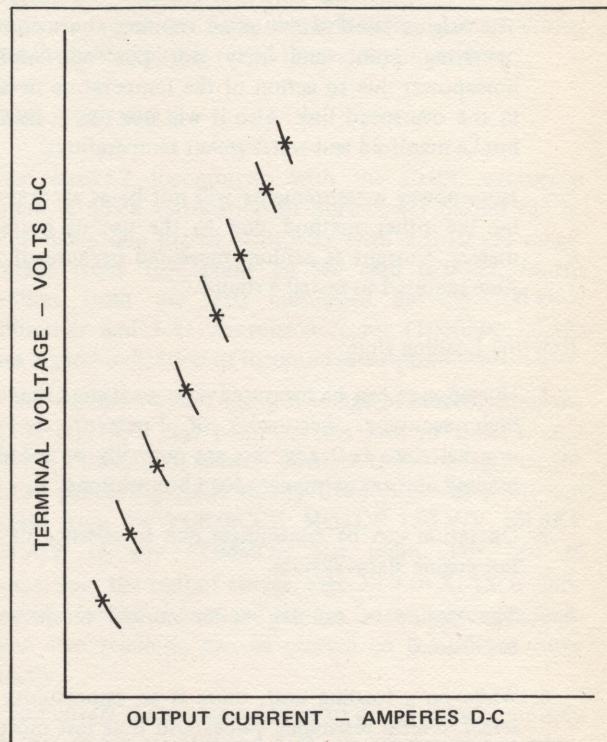


FIG. XI-1. NOTCH SPREAD ALONG SELF-LOADING RESISTANCE LINE.

Each of the loading methods has certain advantages as listed here for comparison.

Self Loading

1. This is a very quick way to check locomotive output (engine horsepower). Very little set-up time is required, and a 0-10 vdc meter is the only test equipment needed.

XI

2. An excellent means of testing nearly all of the systems on the locomotive. Although it is done at a single value of resistance, Fig. XI-1, it will give the output for each of the eight Throttle notch positions.
3. It can be accomplished almost anywhere on railroad property, but preferably not inside a building since this could overheat the sprinkler system and cause other problems. During summer the hot engine alarm may ring on the locomotive.
4. The engine itself will not be running at its correct operating point and may not put out normal horsepower due to action of the temperature derater in the overspeed link. Also it will not run at normal intake manifold and water jacket temperatures.
5. Horsepower measurements will not be as accurate as by the other method due to the use of portable meters. Current is seldom measured because of the time required to install a shunt.

External Loading Unit

1. Horsepower can be measured with great precision and high accuracy. Accuracies of 1 percent are not unusual since better meters are normally provided in loading units at permanent load box stations.
2. Operation can be continuous due to absence of the hot engine alarm system.
3. The engine is running under normal temperature conditions.
4. While on a loading unit, there is an opportunity to select several resistance values and thus test most of the excitation curve, Fig. XI-2.
5. During load testing, Power Matching can be set or checked.

SELF LOADING

DESCRIPTION

A diesel-electric locomotive with this feature can be isolated while in a multiple-unit consist and using its dynamic braking resistors for an electrical load, can have its own power output, engine speeds and excitation system checked in each of the eight throttle notches. This can be done without uncoupling the locomotive from the others, and in a very short period of time.

Results of the test will quickly determine if the locomotive is suitable for continued service, if repairable or if it should be shopped for a serious malfunction.

A locomotive is equipped with the self-loading feature if it has a Self-Load light on the Engine Control (EC) panel,

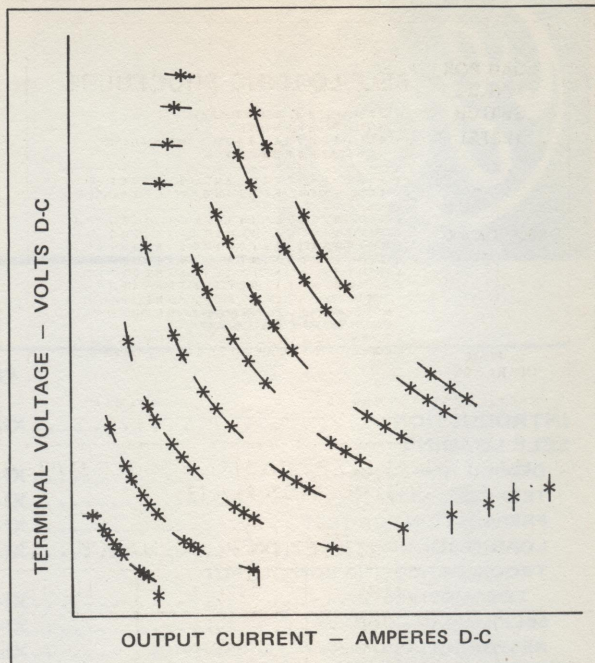


FIG. XI-2. NOTCH SPREAD ALONG TEN RESISTANCE LINES OF EM99 LOADING UNIT.

Fig. XI-3, and the Load Box Toggle Switch (LBTS) located at top left center of upper control compartment. The switch is mounted on an instruction plate, like Fig. XI-4, for the C30-7 model locomotive. Instructions plates for other models are the same except for values in Table XI-I.

CAUTION: *Prolonged testing with ambient temperatures above 65 F could damage equipment due to excessive heat.*

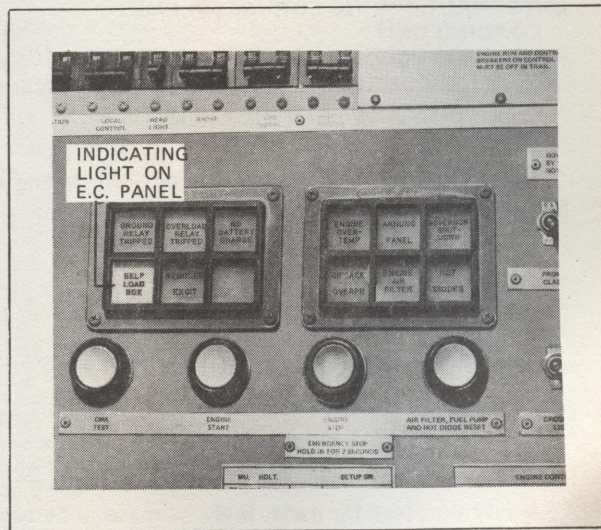


FIG. XI-3. LOCATION OF SELF-LOAD BOX LIGHT ON ENGINE CONTROL PANEL.

FIG. XI-2, E-25391

FIG. XI-3, E-25392

FIG. XI-4, E-25393

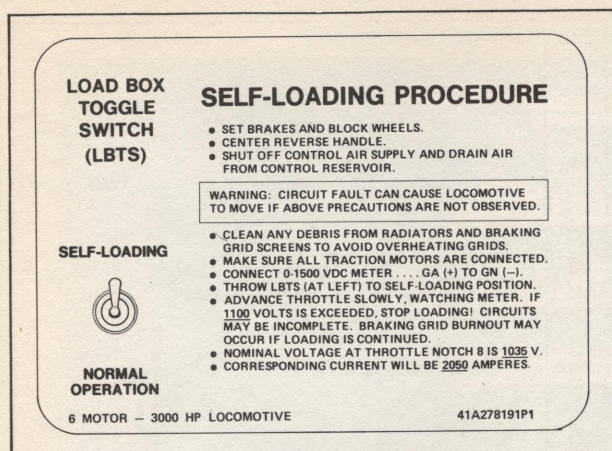


FIG. XI-4. TYPICAL SELF-LOADING TOGGLE SWITCH INSTRUCTION PLATE.

TABLE XI-I, INSTRUCTION PLATE VALUES

Model	First	Second	Third
B18-7	1100	980	1300
B23-7	1200	1110	1470
C23-7	1190	1110	1440
B28-7	1280	1225	1500
C28-7	1060	990	1950
B30-7	1320	1280	1660
C30-7	1100	1035	2050
B36-7	1300	1210	2120
C36-7	1240	1140	2260

TEST EQUIPMENT

One to three 0-10 vdc digital voltmeters.

PREPARATION FOR TEST

A locomotive to be self loaded is electrically isolated from the other locomotives if in a consist of multiple locomotives (MU). This is done by uncoupling the 27-point MU jumpers at each end of the locomotive under test. The air brakes must be properly set to prevent possible movement during the test. Individual locomotives should also have the wheels chocked or blocked.

To prevent application of power to the traction motor circuits, CLOSE air supply cock at control air NS-1 reducing valve and OPEN the control air reservoir drain cock (or insert insulation between main contacts of S and P contactors).

Since some of the motor fields are in the circuit during self loading, do not test with damaged traction motors, a traction motor cut-out or other defects in the power circuits.

Before starting test, check all radiator cab intake screens and underside of radiators to be sure they are clear and free of debris, to insure proper cooling.

The loadmeter on operator's console is bypassed during self loading, so an external ammeter with shunt may be desired. If so, connect the shunt in series with the ACCR reactor, keeping the ACCR in the circuit.

The air for cooling the braking grids also passes up through the radiators that cool the water. If the ambient temperature gets too high, the Hot Water alarm will ring after the heated air has raised the water temperature.

LOAD TESTING

On Series-7 locomotives with the CHEC excitation system, a quick verification of horsepower output can be made using one digital voltmeter with a 0-10 vdc range. Voltage from Test Point on MP card (FD735, fourth position from the left) multiplied by the 300 kw/v calibration and 1.41 conversion factor ($1000/746 \times 0.95$) gives a good indication of locomotive output.

This can be verified using readings of current from the ACCR 600 A/V test point on the face of the FL card (FD738 Filter Card, seventh position from the left), on the FL138 panel, Fig. XI-5, to any COMMON test point and voltage from the VCR/BCCR, MOTOR 150 V/V, BRAKE 100 A/V to any COMMON test point. For ease of comparison, the output curves, Figs. XI-7 to XI-15, include scales for actual values and for the 0-10 v meter readings. These two readings, can be plotted on the output curve directly.

To convert the meter readings to actual values, multiply the indications by 600 and 150 respectively (the numbers printed beside the test points). These values can be plotted on the output curve using actual values for voltage and current.

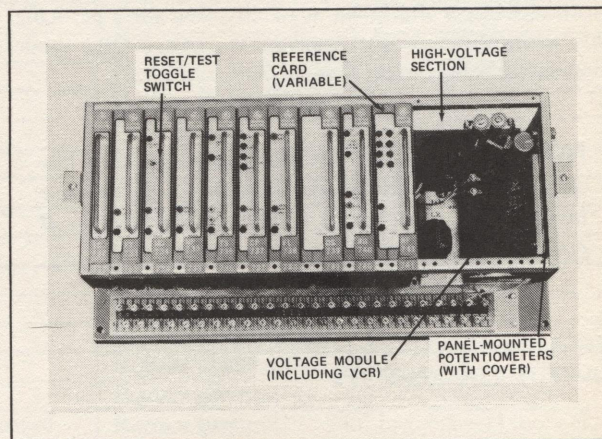


FIG. XI-5. FL138 CHEC EXCITATION PANEL WITH HIGH-VOLTAGE SECTION EXPOSED.

FIG. XI-5, E-20343

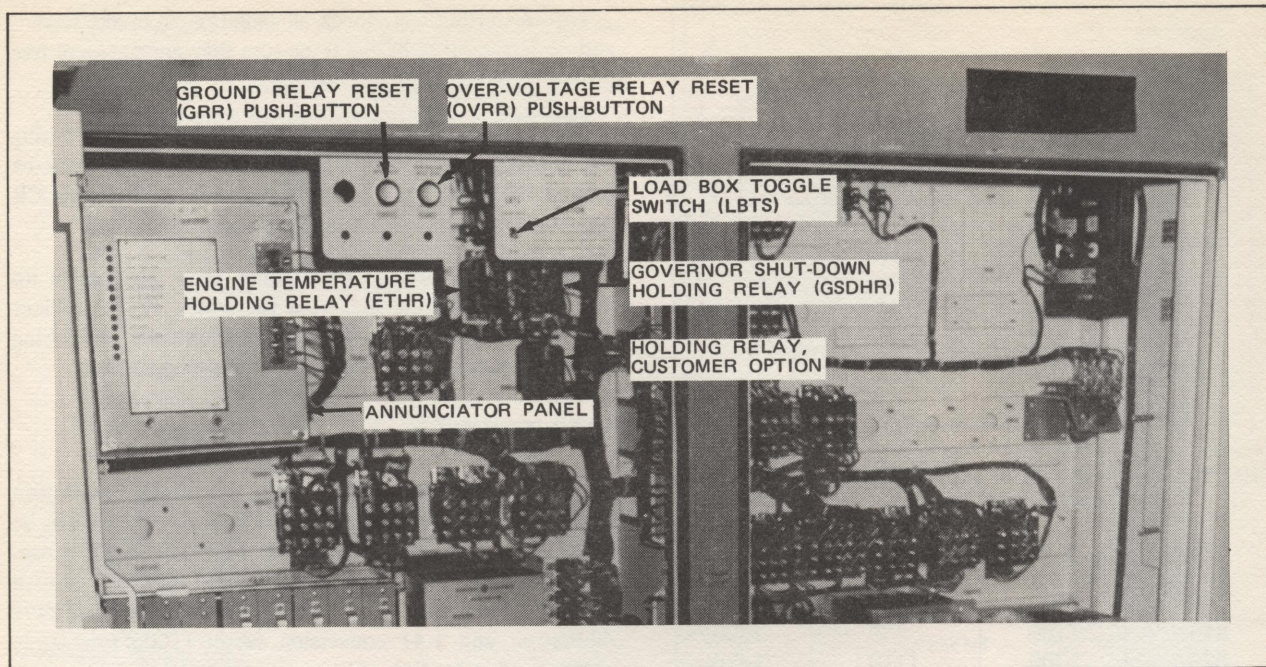


FIG. XI-6, E-25039

FIG. XI-6. LOCATION OF SELF-LOADING TOGGLE SWITCH (LBTS) AND INSTRUCTION PANEL.

With the Throttle handle in the OFF position and the Reverse handle in FORWARD, the engine idling (at operating temperature), snap the Load Box Toggle Switch (LBTS, located in the upper control compartment) to the SELF LOAD position, Fig. XI-6. The light on the EC panel should now light, Fig. XI-3.

The Throttle handle can then be moved to each of the eight notch positions. Engine speed for each notch is the same as for normal motoring. Output in each throttle position can be compared with the corresponding point on the curve to verify the locomotive output. This is done by plotting each of the meter readings taken for a particular throttle position on the appropriate curve for the model locomotive being tested, Figs. XI-7 thru XI-15.

NOTE: *If points do not plot along resistance line shown, refer to schematic diagram for locomotive being tested. Verify the combined resistance – it could be different than the one shown.*

TROUBLE-SHOOTING LOW OUTPUT LOCOMOTIVES

Further diagnosis of reasons for partial output can then be undertaken in Tables XI-II and XI-III.

RESTORING LOCOMOTIVE FOR SERVICE

1. Move Toggle switch LBTS to RUN position
2. Remove all test equipment and restore all circuits to normal which may have been modified for the test.

EXTERNAL LOADING

DESCRIPTION

A load test should be performed periodically to assure the locomotive power plant is producing rated horsepower, especially after a major overhaul of power plant or replacement of equipment.

This instruction is a guide for checking the output of a power plant using the EM99 Loading Unit. The load test may be applied to adjust the output of an overhauled engine or to determine the condition of an engine while in service on a locomotive. A tabulation of accumulated test data can aid in determining the effectiveness of overhaul work on a rebuilt engine and guide maintenance work to improve engine performance.

This instruction assumes an ungrounded resistor-blower type loading unit will be used. However, this does not prohibit the use of any other type loading device or unit, since the test preparations, connections and procedure will be similar.

TABLE XI-II, LOW HORSEPOWER OUTPUT – POSSIBLE CAUSES:

Item	Problem	Possible Cause	Correction
ELECTRICAL ITEMS			
1E	Low Control Voltage	Voltage regulator failure	Reset rheostat, replace or repair panel
2E	Low Voltage Power Supplies on CHEC Panel +15 and -15 vdc	Faulty FD740, "RG" Card	Replace or repair FD740 card
3E	Reduced Excitation Mode of Operation. LED ON on FD734 card	Any defect causing continuous turn on of FT card False Turbo Signal Wheelslip Signal	Correct fault, move switch to RESET position
		Defective FT card	Replace or repair FD733 card
4E	Low Excitation Operation	Inaccurate test meters	Reset with calibrated meters
		Traction motors cut-out	Reset switch
		High lube-oil temperature	Check oil cooler operation
		FD738 Filter card out of calibration	Replace card
		ORS Engine Governor Solenoid energized in error	Fix circuit
		Extraneous signal on H Terminal of CHEC Panel	Check Speed Event or Wheelslip Panel outputs. (Should be zero volts at standstill.)
	Bad CMR "ACCR" reactor	Replace reactor	
5E	Low Alternator Output	Power Limit switch in NOTCH 7 Position (400-600 hp low in Notch 8 only).	Reset switch to NORMAL
		Running single phase	Check each phase voltage
		Filter card FD738 out of calibration for ACCR or VCR	Replace card, check ACCR or VCR
MECHANICAL ITEMS			
1M	Poor Combustion	Incorrect pump timing	Retime engine
		Incorrect valve tappet clearance	Readjust to proper clearances
		Air leaking from intake manifolds or elbows (turbo to intercooler)	Replace O-rings, bent or broken manifold sections
		Racks not set properly	Readjust all injection pump racks to same correct setting
		Carbon build-up in cylinder inlet ports	Remove air inlet manifolds and clean ports
		Fuel has low heating value	Submit sample for lab. test
		Faulty fuel injectors	Replace bad injectors
2M	Overspeed Derator Link Expanded	High ambient temperature	Clean intercoolers (air side and/or water side)
		High manifold temperature	Clean intercoolers (air side and/or water side)
		Low oil pressure	Faulty pump or regulator in Overspeed Governor
3M	Low Fuel-Oil Pressure	Plugged filter elements	Replace elements
		Plugged strainer	Clean strainer
		Regulator valve set low	Recalibrate valve
		Suction pipe admitting air	Tighten fittings or replace tubing, pipes or hoses
4M*	Engine Control Governor Modulating	Low lube-oil pressure	Correct cause of low pressure
		Low water pressure	Correct cause of low pressure
5M	Low Turbocharger Speed	Cold lube oil	Let system warm up
		Bearing problem	Replace turbocharger
		Carbon build-up	Replace turbocharger
6M	Engine Control Governor Malfunction	Air leak in tube to manifold	Replace or mend tube
		Air sensor malfunction	Replace governor
		Load control pilot valve unbalanced at 0.344 in. with air OK	Replace governor
		Binding fuel linkage	Clean, free up and lubricate

*When Provided

TABLE XI-II, E-25422

TABLE XI-III, EXHAUST SMOKE ANALYSIS

Item	Indication	Possible Cause	Correction
1	Black Smoke Puffs	One or more defective injectors	Recondition or change the defective injector.
		Fuel pump rack is stuck	Free the rack or change the pump.
		Fuel pump rack is set too high	Locate the high rack and readjust.
		Fuel pump rack is out of time	Adjust timing.
		Worn or damaged turbocharger	Repair or replace turbocharger.
		Broken or leaking manifold pipes	Repair or replace the manifold.
		Engine speed is bogging down	Check the engine operation and circuits for fault.
		Turbocharger surging	Inlet ports partially blocked or turbocharger misassembled (nozzle ring and diffuser). Clean cylinder inlet ports if dirty.
2	White Smoke Puffs	Turbocharger rotor is stuck	Replace turbocharger.
		Fuel pump is out of time	Adjust timing.
		Cylinder with valves burned or stuck open	Replace cylinder.
		Engine is too cold	Wait until engine warms up.
		Cylinder with low compression	Replace cylinder.
3	Blue Smoke and Oil Out the Stack	Fuel system is air bound	Bleed the fuel system.
		Failed turbocharger bearings and seals	Replace turbocharger.
		Worn or broken piston rings	Replace rings.
		Cracked piston crown	Replace piston and rings.
		Scored liner	Replace cylinder and rings.
4	Steady Smoke	Prolonged operation at IDLE	Load engine and condition should clear up.
		Worn or leaking injectors	Change injectors.
5	Water Out Stack	Late pump timing on all cylinders	Time the injection pumps.
		Cylinder seal leaks or cracked turbocharger	Locate and correct.
6	"Blow" in Exhaust System	Cylinder valve is stuck open	Replace cylinder.
		Cylinder valve seat is "guttered"	Replace cylinder.
		Broken exhaust manifold section	Repair or replace manifold or manifold section.
		Valve tappet clearance is insufficient	Readjust valve tappets.

TABLE XI-III, E-25423

WARNING: To protect against fatal injury from electrical shock, DO NOT proceed with load test until both the frame of the loading device and the locomotive are properly grounded.

TEST EQUIPMENT AND SPECIAL TOOLS

Loading device with connecting cables and meters, recently calibrated to $\pm 1/4$ percent accuracy; either a Loading Unit like an EM99 or a water box arrangement 5EM99D1

Part No.

Part No.

Ammeter with calibrated shunt 0-6000 adc
(If meter on loading device not accurate)

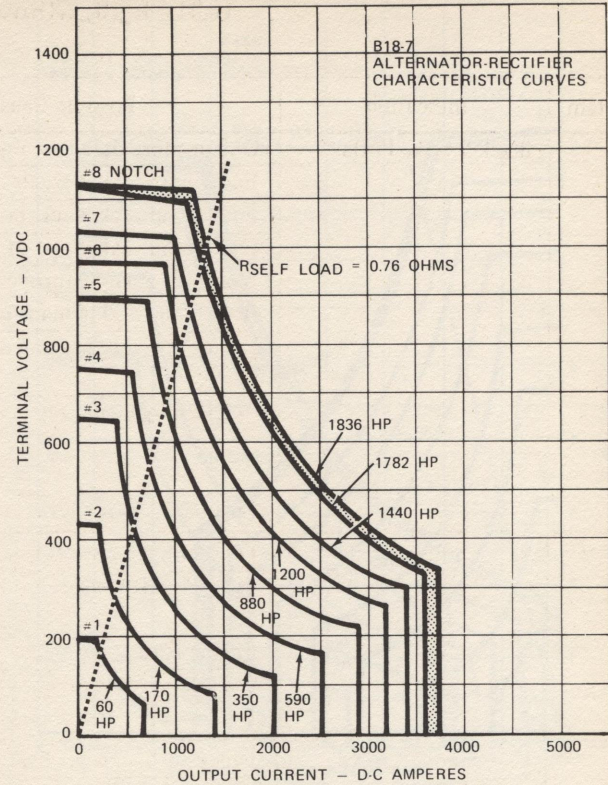
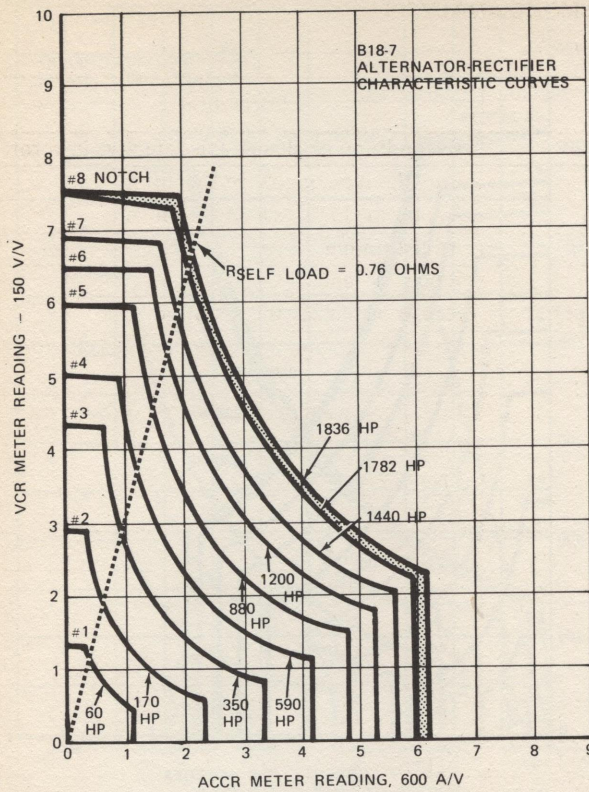
Voltmeter 0-1500 vdc
(If meter on loading device not accurate)

Voltmeter 0-150 vdc

Tachometer, 0-1500 rpm 2X2795

Overspeed Test Lever 147X2016

FIG. XI-7, E-25355



AVERAGE READINGS FOR SELF LOADING A B18-7 LOCOMOTIVE ON ITS DYNAMIC BRAKING GRIDS OF 0.76 OHMS RESISTANCE.

NOTCH	LEFT CURVE			RIGHT CURVE			
	ACCR CARD 7	VCR CARD 7	POWER CARD 4	CURRENT AMPERES	VOLTAGE VOLTS	POWER KW	POWER HP
8	2.17	6.60	4.29	1300	990	1285	1815
7	1.93	5.87	3.40	1160	880	1020	1440
6	1.77	5.37	2.84	1060	805	855	1205
5	1.49	4.53	2.03	895	680	610	860
4	1.22	3.70	1.35	730	555	405	570
3	0.93	2.83	0.79	560	425	240	335
2	0.60	1.83	0.33	360	275	100	140
1	0.38	1.13	0.13	225	170	40	55

FIG. XI-7. SELF LOADING A B18-7.

PREPARATIONS FOR TEST

1. Chock or block the wheels during test to prevent possible locomotive movement.
2. Disable the Power Matching feature during the load test (if locomotive is so equipped) by lifting wire from Terminal L and applying jumper between Terminals EXP-L and EXP-M on FL138 excitation panel.
3. If desired to unload air compressor for duration of test, jumper +75 vdc to coil of magnet valve. This

keeps compressor from loading, which would cause extra load on the engine.

4. Load Test connections — refer to the locomotive Schematic and Connection Diagrams.
 - a. Disconnect all the traction motor cables at the positive terminal at the power rectifier panels. Do not disconnect the small control wire, GA, since it is required to control the excitation system. Connect the positive cables of the loading device in place of the motor cables just removed,

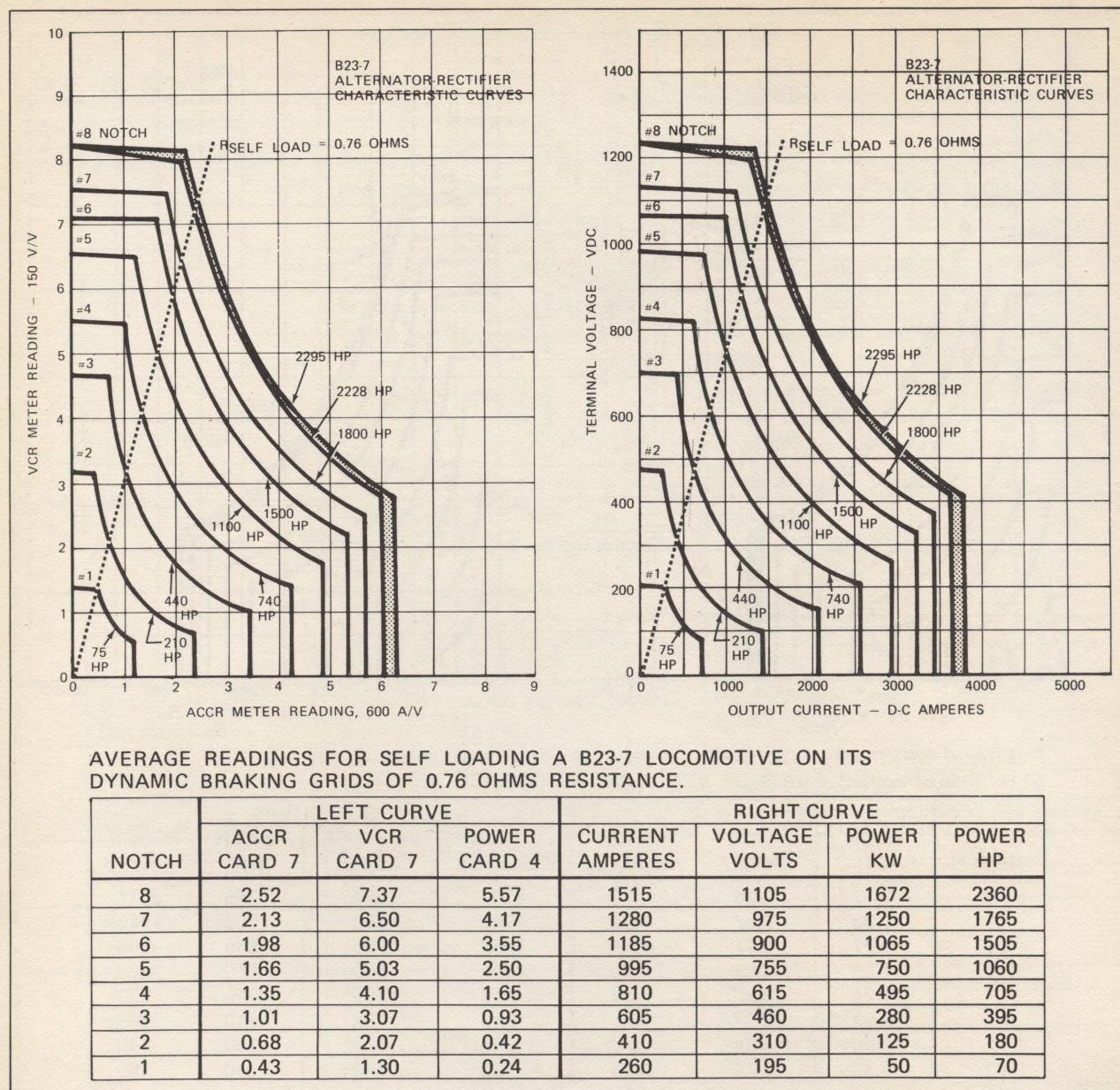


FIG. XI-8. SELF LOADING A B23-7.

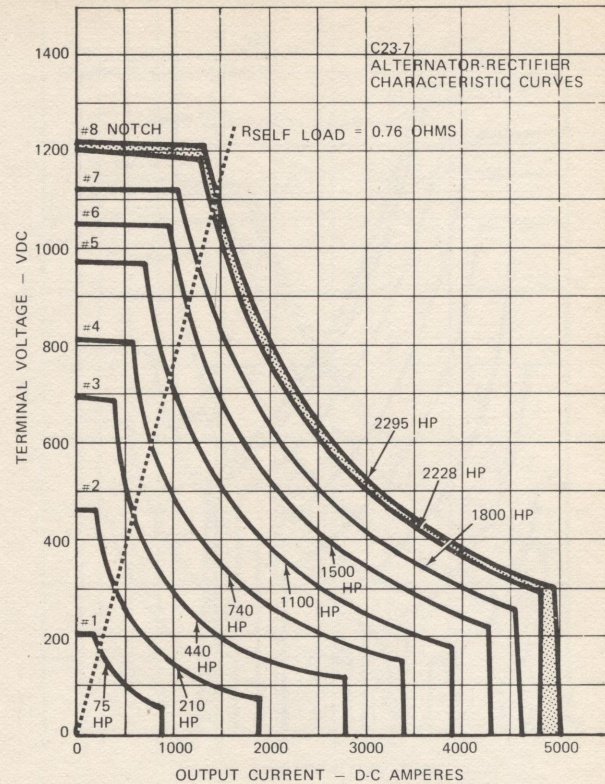
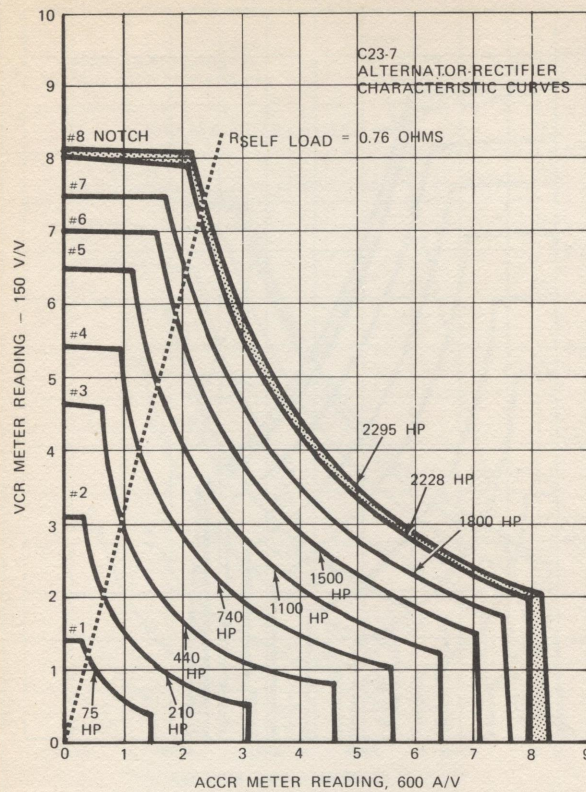
FIG. XI-8, E-25356

Fig. XI-16. Assure the load test cables are of sufficient size to safely handle the maximum load current used in the test. Thoroughly insulate the cable lugs removed above so no contact can be made at anytime during the test.

NOTE: When connecting cable or wire lugs, be sure the lugs have flat, clean mating surfaces and be sure the correct size and quantity of hardware is used to properly make the connection. Apply joint compound (T&B M-53, No. 21059 or GE 41A204944P1). This will prevent "hot spots" at the connections and prevent loss of power.

- b. Disconnect and insulate all the traction motor cables at the current reactor, ACCR in the lower compartment, Fig. XI-17. All load current must pass through ACCR during the test. Do not disconnect the small GN wire from the load test circuit. Connect the negative cables of the loading device to the negative end of the reactor, to assure the load current passes thru the reactor during the load test. Include a current-measuring shunt in the negative cables to the loading device if an accurate loadmeter is not built into the loading unit.

FIG. XI-9, E-25357



AVERAGE READINGS FOR SELF LOADING A C23-7 LOCOMOTIVE ON ITS DYNAMIC BRAKING GRIDS OF 0.76 OHMS RESISTANCE.

NOTCH	LEFT CURVE			RIGHT CURVE			
	ACCR CARD 7	VCR CARD 7	POWER CARD 4	CURRENT AMPERES	VOLTAGE VOLTS	POWER KW	POWER HP
8	2.43	7.40	5.40	1460	1110	1620	2285
7	2.15	6.53	4.21	1290	980	1264	1785
6	1.97	6.00	3.56	1185	900	1065	1505
5	1.64	5.00	3.48	985	750	740	1045
4	1.36	4.13	1.68	815	620	505	715
3	1.03	3.13	0.97	620	470	290	410
2	0.68	2.06	0.59	410	310	125	180
1	0.44	1.33	0.18	265	200	55	75

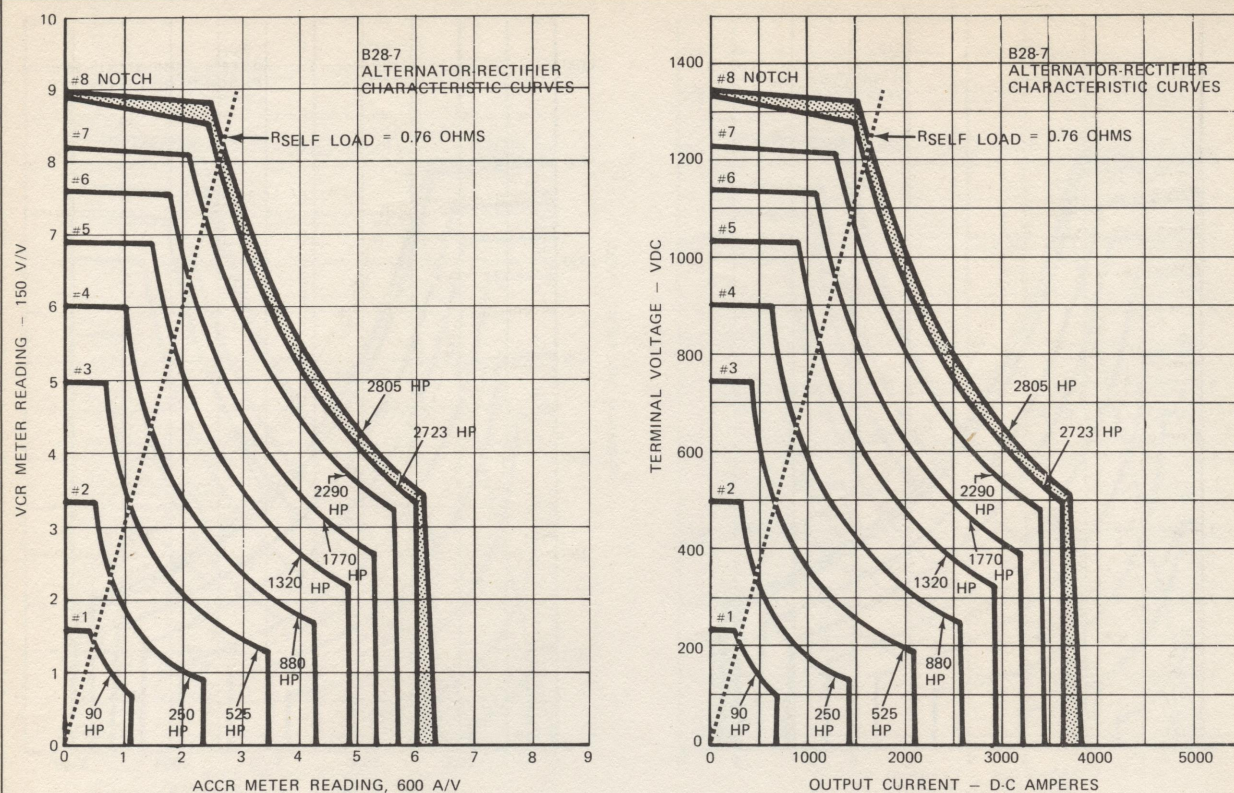
FIG. XI-9. SELF LOADING A C23-7.

WARNING: Proper precautions must be taken to protect personnel from possible contact with the high-voltage meter wiring. Suggest all meters be enclosed in a large box with clear plastic protective cover.

- c. If there is no accurate voltmeter in the loading device, connect a 0-1500 vdc voltmeter across the power rectifiers at Terminals GA to GN. It is important the cables to and from the loading device be of sufficient size and quantity to keep the voltage drop thru the cables at a minimum.

NOTE: It is important that all meters used in load-testing be accurate and calibrated quarterly. The accuracy of the meter calibration will determine the precision of the horsepower calculation. Digital-type meters are recommended, due to their retention of calibration; however, do not apply them at voltages in excess of their rating, and always unplug them from wayside charging during usage.

- d. Connect a 0-150 vdc voltmeter at the Reverse Current Diode Panel, 17FM203, from cathode side to 4 wire (or N wire) of the battery-charging



AVERAGE READINGS FOR SELF LOADING A B28-7 LOCOMOTIVE ON ITS DYNAMIC BRAKING GRIDS OF 0.76 OHMS RESISTANCE.

NOTCH	LEFT CURVE			RIGHT CURVE			
	ACCR CARD 7	VCR CARD 7	POWER CARD 4	CURRENT AMPERES	VOLTAGE VOLTS	POWER KW	POWER HP
8	2.69	8.17	6.57	1610	1225	1970	2785
7	2.41	7.33	5.30	1445	1100	1590	2245
6	2.10	6.40	4.05	1265	960	1215	1715
5	1.83	5.57	3.06	1100	835	920	1295
4	1.42	4.33	1.85	855	650	555	785
3	1.10	3.33	1.10	660	500	330	465
2	0.77	2.33	0.54	460	350	161	225
1	0.47	1.43	0.20	285	215	60	85

FIG. XI-10. SELF LOADING A B28-7.

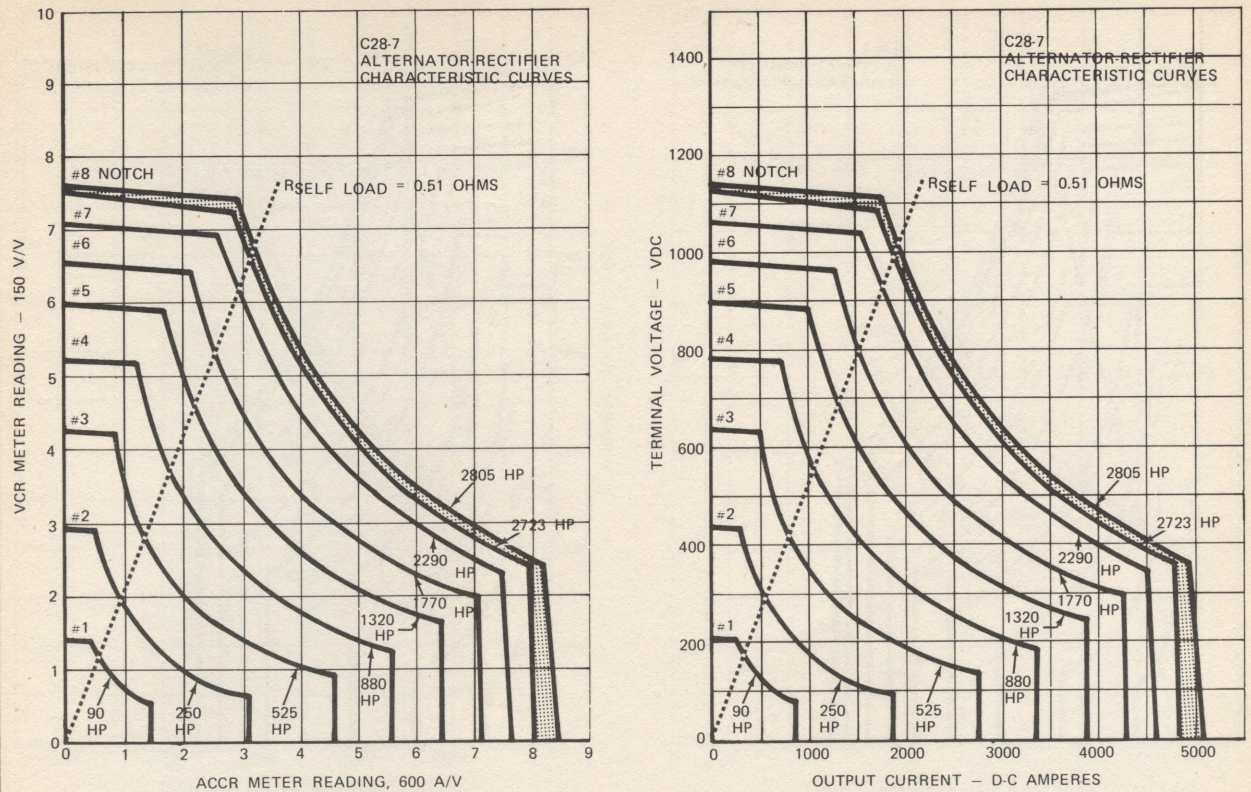
circuit. This meter will read charging volts. Do not attempt to read battery volts across the blades of the battery switch or across the voltage regulator.

- e. Install a 0-1500 rpm tachometer-generator, Tool 2X2795, with matching digital meter, to the engine. Apply the tachometer-generator at the 1/2-in. pipe plug opening behind the overspeed governor, on the right side of the engine, Fig. XI-18.

NOTE: A hand tachometer with extension can be used by applying it at the same location.

- f. Shut off air supply to NS-1 Control Air reducing valve. Drain control air reservoir to prevent any possible operation of contactors during the test or remove and insulate the battery power wire, EF, from the EC switch to the reverser and GR to GOLR interlock, to eliminate control power from all the power contactors.
5. If a corrected horsepower check is to be made, measure the fuel temperature in the fuel line to the engine (between the secondary fuel filter and the header). Read the ambient air temperature and barometric pressure just before and after horsepower

FIG. XI-11, E-25359



AVERAGE READINGS FOR SELF LOADING A C28-7 LOCOMOTIVE ON ITS DYNAMIC BRAKING GRIDS OF 0.51 OHMS RESISTANCE.

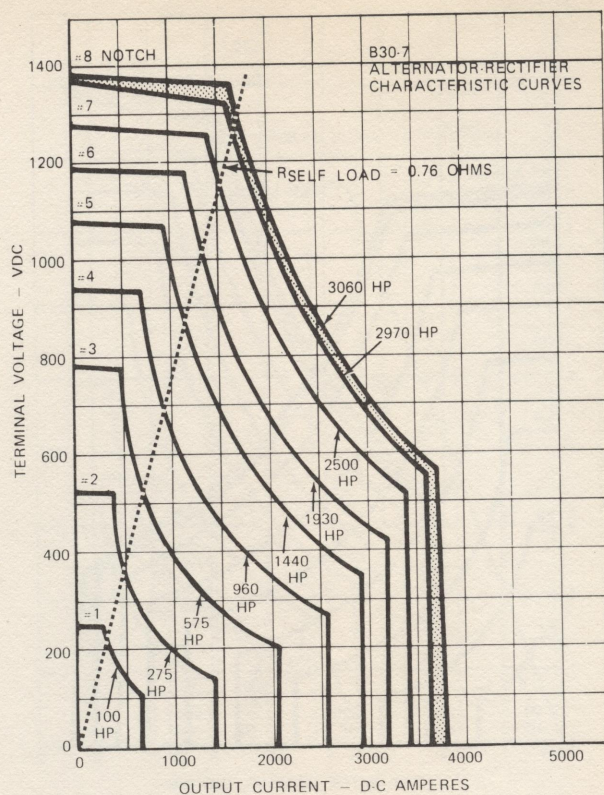
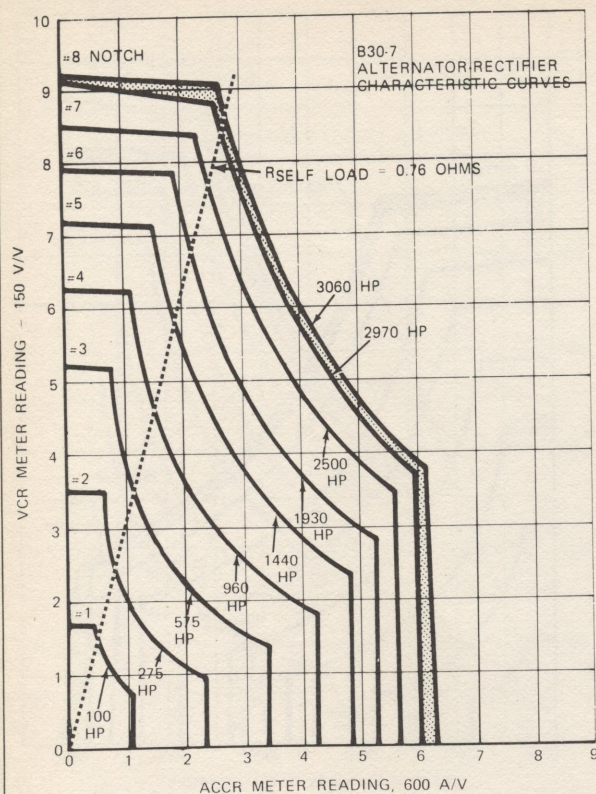
NOTCH	LEFT CURVE			RIGHT CURVE			
	ACCR CARD 7	VCR CARD 7	POWER CARD 7	CURRENT AMPERES	VOLTAGE VOLTS	POWER KW	POWER HP
8	3.30	6.73	6.67	1980	1010	2000	2820
7	3.02	6.17	5.60	1815	925	1680	2370
6	2.63	5.37	4.24	1580	805	1270	1795
5	2.29	4.67	3.20	1370	700	960	1355
4	1.83	3.73	2.05	1100	560	615	870
3	1.39	2.83	1.18	835	425	355	500
2	0.98	2.00	0.59	590	300	175	250
1	0.57	1.17	0.20	345	175	60	85

FIG. XI-11. SELF LOADING A C28-7.

check of the load test. If accurate barometer is not available, use the elevation of the test site. See **CALCULATING GROSS ENGINE OUTPUT** in Load Testing Instructions under Section ET-2 of Maintenance Manuals.

Power Plant Operation

1. Check the engine for proper level of cooling water, lubricating oil, fuel oil and governor oil, so the load test can be completed without stopping.
2. Check the level of the lubricating oil in the air compressor, traction generator gear unit and radiator fan gear unit.
3. Check the fuel linkage system on the engine to see that it is properly lubricated and operates freely. Also check output pressure of the fuel oil pump. It should be 40 psi.
4. Check all rotating apparatus for loose or broken brushes and any foreign material. Correct any unsatisfactory condition found, before proceeding.



AVERAGE READINGS FOR SELF LOADING A B30-7 LOCOMOTIVE ON ITS DYNAMIC BRAKING GRIDS OF 0.76 OHMS RESISTANCE.

NOTCH	LEFT CURVE			RIGHT CURVE			
	ACCR CARD 7	VCR CARD 7	POWER CARD 4	CURRENT AMPERES	VOLTAGE VOLTS	POWER KW	POWER HP
8	2.74	8.33	6.85	1660	1280	2125	3000
7	2.48	7.53	5.59	1485	1130	1680	2370
6	2.17	6.60	4.29	1300	990	1285	1815
5	1.88	5.70	3.21	1125	855	960	1355
4	1.50	4.57	2.06	900	685	615	870
3	1.14	3.47	1.19	685	520	355	505
2	0.80	2.43	0.58	480	365	175	245
1	0.49	1.50	0.22	295	225	65	95

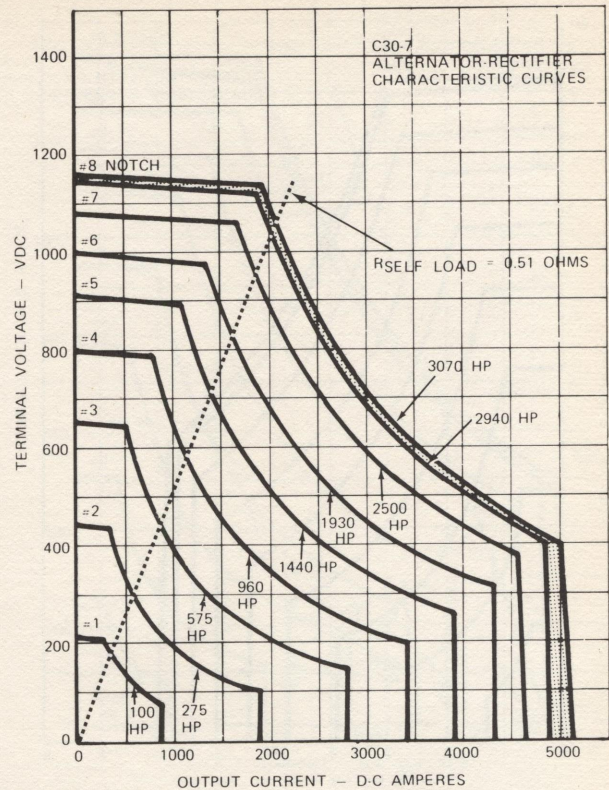
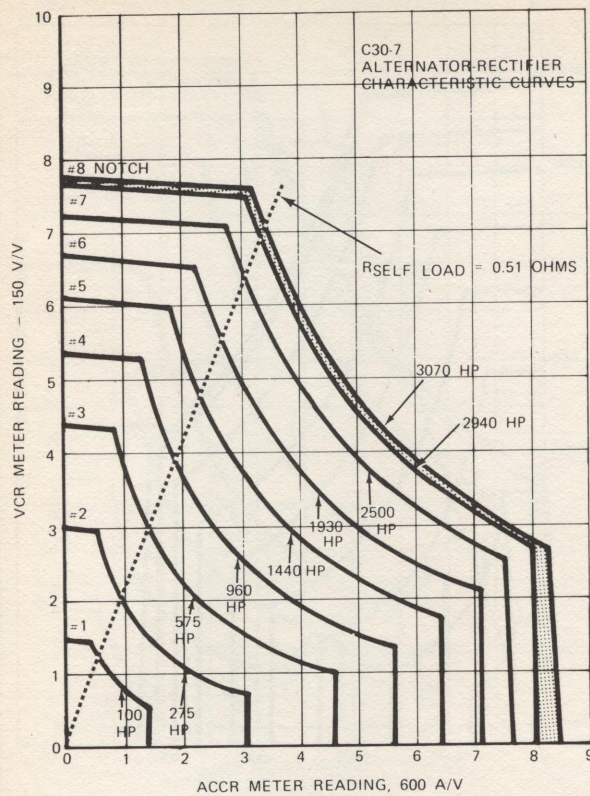
FIG. XI-12. SELF LOADING A B30-7.

FIG. XI-12, E-25360

5. Check that no warning devices are tripped, such as the engine air filter indicator. Remove the air supply hose to the Overspeed and Fuel Control Device (Overspeed Link under engine control governor) at the device, and plug the hose fitting.
6. Preset the loading device so the highest resistance is in the circuit prior to starting the engine. Then check that the circuit thru the loading device is OPEN during engine starting to minimize drain on the battery.

7. Start the engine. If the engine has been overhauled, follow the break-in procedure as listed in publication found in Section DE-15 of Maintenance Manuals. Check for system leaks or any sign of distress. Correct any faults before proceeding.
8. Turn off all nonessential auxiliary loads like lights, electric cab heaters and water coolers; also batteries are to be fully charged. Derater link must not be derating. Fuel strainer and fuel filters must be clean.

FIG. XI-13, E-25361



AVERAGE READINGS FOR SELF LOADING A C30-7 LOCOMOTIVE ON ITS DYNAMIC BRAKING GRIDS OF 0.51 OHMS RESISTANCE.

NOTCH	LEFT CURVE			RIGHT CURVE			
	ACCR CARD 7	VCR CARD 7	POWER CARD 4	CURRENT AMPERES	VOLTAGE VOLTS	POWER KW	POWER HP
8	3.38	6.90	7.00	2050	1035	2125	3000
7	3.09	6.30	5.84	1855	945	1755	2475
6	2.68	5.47	4.40	1610	820	1320	1865
5	2.32	4.73	3.29	1390	710	985	1390
4	1.88	3.83	2.16	1125	575	645	915
3	1.44	2.93	1.27	865	440	380	535
2	0.98	2.00	0.59	590	300	175	250
1	0.60	1.23	0.22	365	185	70	95

FIG. XI-13. SELF LOADING A C30-7.

- Check Power Limit switch on operator's console to be sure it is in the NORMAL (Notch 8), NOT the NOTCH 7 position.

Voltage Regulator Check

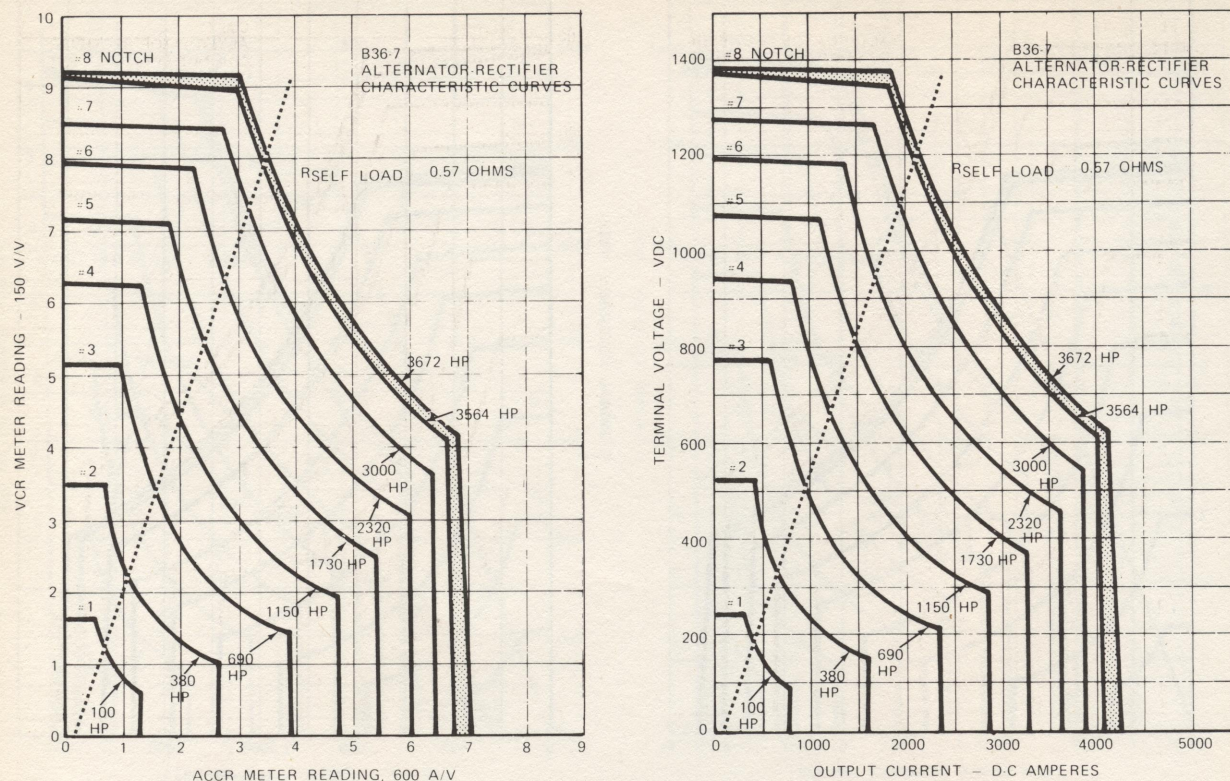
Before proceeding with the load test, check the voltage regulator for proper regulation at between 73.5 and 74.5 volts at both IDLE and FULL engine speeds. Read the voltmeter installed in the battery-charging circuit.

If correction is needed, loosen the locknut on the potentiometer on face of regulator panel, either FH-20 or

FH-23, and turn the adjustment screw to obtain proper voltage; then, again tighten the locknut.

Engine Speed Check

Run the engine in Notch 3 or 4 until the water temperature is 65 C (150 F) or above. Check the engine for proper crankshaft speeds in all notches, and refer to the Engine Control Governor instructions if any adjustment is necessary. The tachometer should read 1553-1568 rpm for a 1045-1050 rpm engine speed.



AVERAGE READINGS FOR SELF LOADING A B36-7 LOCOMOTIVE ON ITS DYNAMIC BRAKING GRIDS OF 0.57 OHMS RESISTANCE.

NOTCH	LEFT CURVE ABOVE			RIGHT CURVE ABOVE			
	ACCR CARD 7	VCR CARD 7	POWER CARD 4	CURRENT AMPERES	VOLTAGE VOLTS	POWER KW	POWER HP P
8	3.53	8.07	8.57	2120	1210	2565	3620
7	3.23	7.37	7.15	1940	1105	2145	3025
6	2.81	6.40	5.40	1685	960	1620	2285
5	2.42	5.53	4.03	1455	830	1210	1705
4	1.96	4.47	2.63	1175	670	790	1110
3	1.52	3.47	1.58	915	520	475	670
2	1.02	2.33	0.72	615	350	215	305
1	0.58	1.33	0.23	350	200	70	100

FIG. XI-14. SELF LOADING A B36-7.

Engine Overspeed Check

With the engine heated to normal operating temperature, run it in IDLE and no-load. Place the special overspeed test lever tool, 147X2016, under the outer cup of the overspeed link, Fig. XI-19. The recess on the back fits over the head of the clamp bolt of the fuel arm connected to the bottom of the link. This is the pivot point for the test lever.

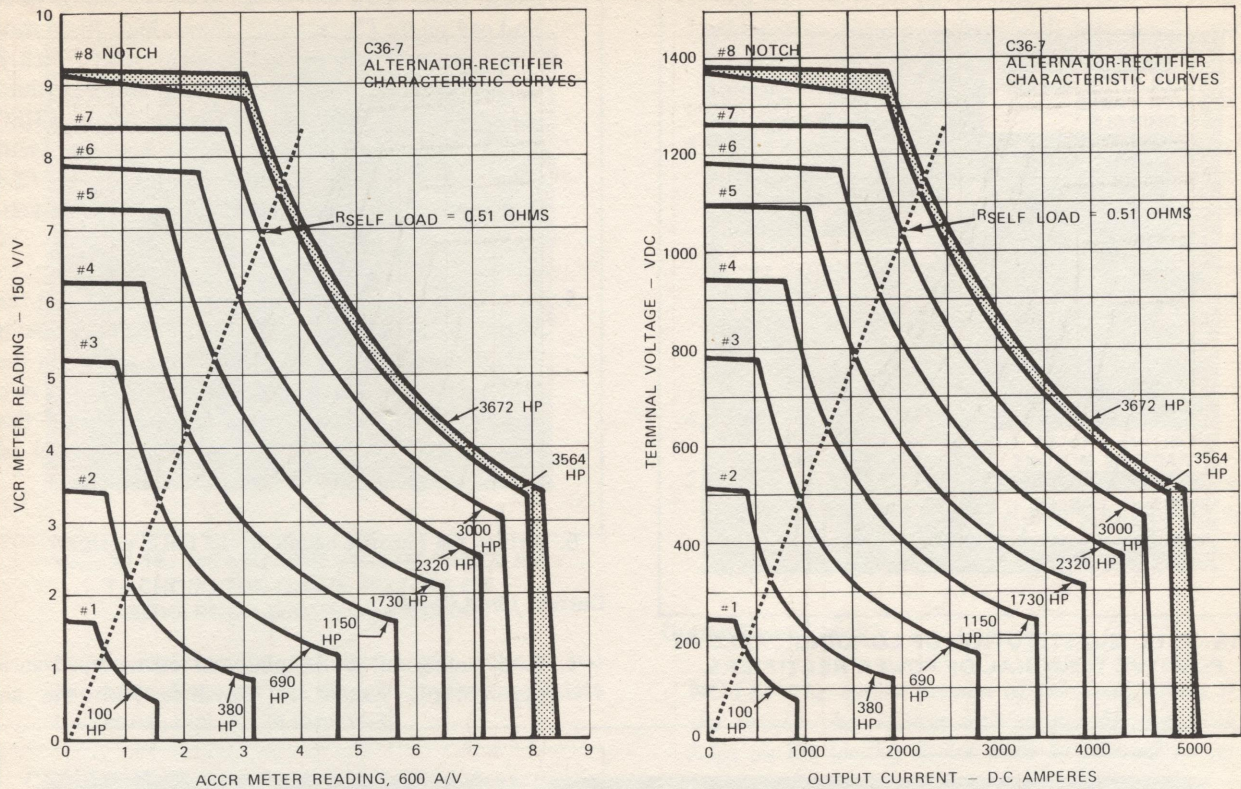
Press down on the end of the tool to raise both the overspeed link and the governor power piston output shaft.

This extends the racks and increases the engine speed. When the trip point of the overspeed governor is reached, it dumps the oil pressure to the link. The link is then permitted to extend and return the racks to the shutdown position. Read the engine speed on the digital meter at the moment the overspeed link extends.

LOAD TESTING

NOTE: Load Test according to local railroad safety regulations.

FIG. XI-15, E-25363



AVERAGE READINGS FOR SELF LOADING A C36-7 LOCOMOTIVE ON ITS DYNAMIC BRAKING GRIDS OF 0.51 OHMS RESISTANCE.

NOTCH	LEFT CURVE			RIGHT CURVE			
	ACCR CARD 7	VCR CARD 7	POWER CARD 4	CURRENT AMPERES	VOLTAGE VOLTS	POWER KW	POWER HP
8	3.76	7.67	8.65	2255	1150	2595	3660
7	3.40	6.93	7.07	2040	1040	2120	2990
6	2.96	6.03	5.37	1775	905	1610	2275
5	2.57	5.23	4.03	1540	785	1210	1710
4	2.09	4.27	2.68	1255	640	805	1135
3	1.62	3.30	1.60	970	495	480	680
2	1.08	2.20	0.72	650	330	215	305
1	0.63	1.30	0.25	380	195	75	105

FIG. XI-15. SELF LOADING A C36-7.

Open-Circuit Voltage Check

With the engine at normal operating temperature, above 65 C (150 F), proceed as follows:

1. Move the Braking handle to OFF, and the Reverse handle to FORWARD or REVERSE position. Move EC (Engine Control) switch to RUN, then close the GF circuit breaker.

WARNING: Electric shock can cause serious or fatal injury. To avoid such injury, personnel must observe proper precautions.

2. Set the loading device on OPEN CIRCUIT.
3. Close the Control circuit breaker on the EC panel, and move the Throttle handle to Notch 4. Observe that the test voltmeter has been properly connected, giving a positive reading. This step checks the voltage at a lower notch to assure the excitation system is operating properly and that it will not produce an excessive voltage in Notch 8 which could severely damage the equipment.
4. Gradually advance the Throttle handle to Notch 8 while checking the open-circuit voltage for each

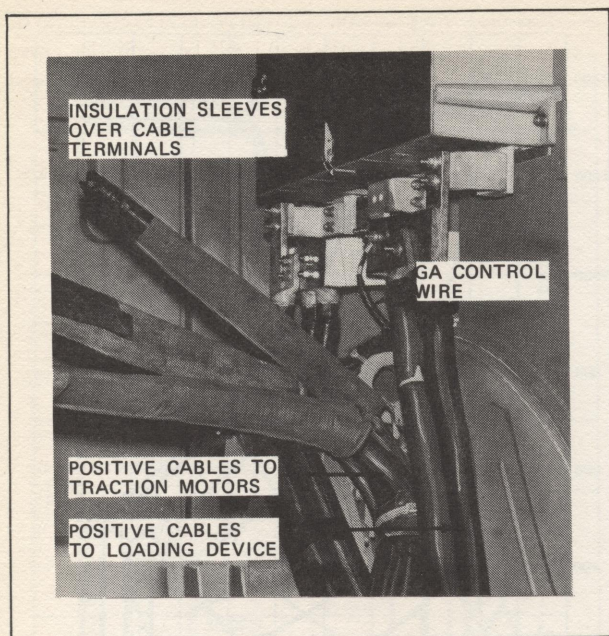


FIG. XI-16. SUBSTITUTION OF LOADING CABLE AT POSITIVE TERMINAL OF POWER RECTIFIERS.

notch. Never allow the voltage to exceed that given at No-Load on the Characteristic Curve, Figs. XI-24 thru XI-32. A small change in the open-circuit Notch 8 voltage can be made by resetting the VL (third potentiometer under right end cover of the CHEC panel). Otherwise proceed to the Current Limit Check, making any required adjustment to CL8 (Potentiometer 4), then repeat the open-circuit voltage check.

5. With the air compressor running unloaded, read the voltmeter across the power rectifiers. The open-circuit voltage should plot between the limits shown on the appropriate Characteristic Curve. This is at the zero current, or the left end, of the curve. See Figs. XI-24 thru XI-32 for the proper model of locomotive being tested.

6. Return the Throttle handle to the IDLE position.

Current Limit Check

1. With loading unit set for minimum resistance, advance the Throttle handle to Notch 4. With the air

FIG. XI-16, E-22784

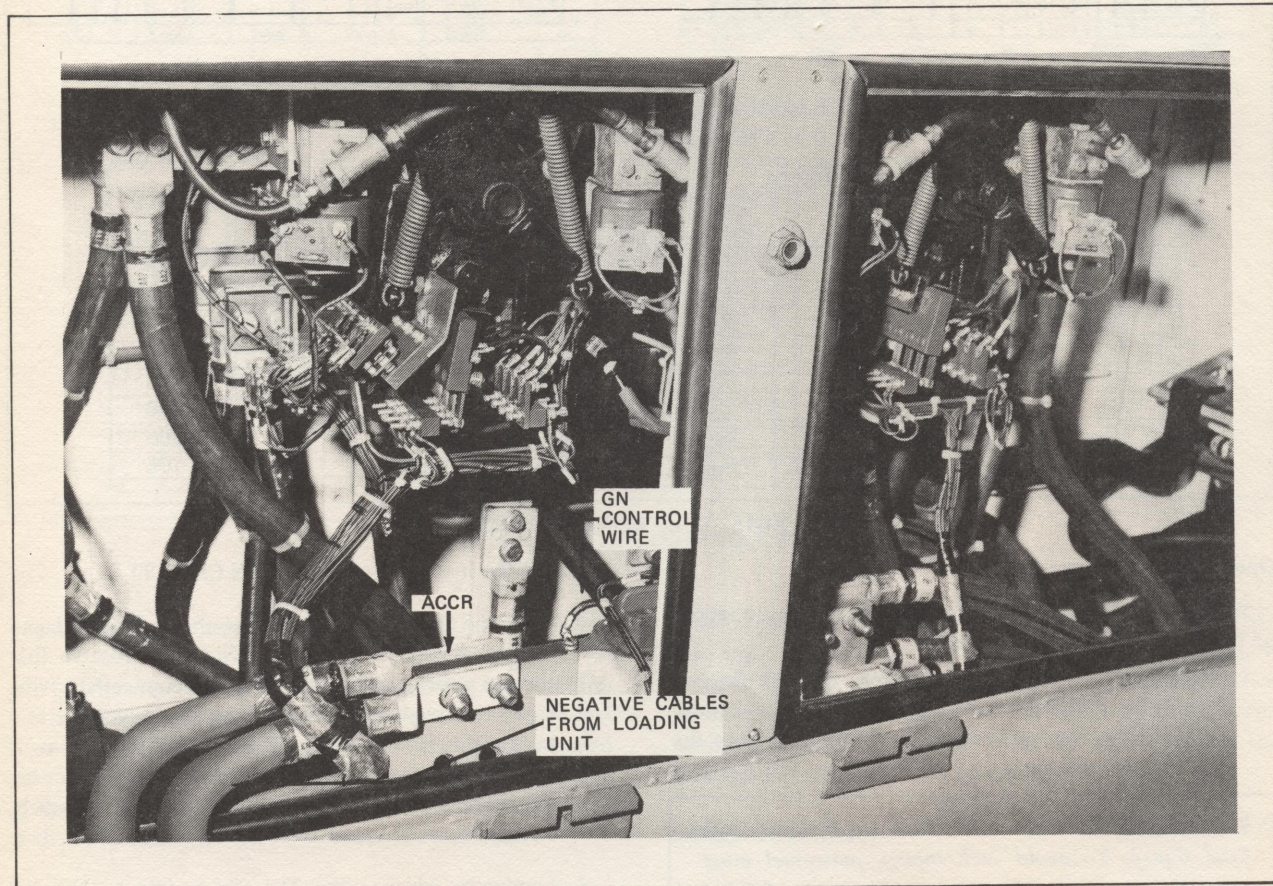


FIG. XI-17. SUBSTITUTION OF LOADING CABLES AT NEGATIVE TERMINAL ON ACCR.

FIG. XI-17, E-25398

FIG. XI-18, E-20949

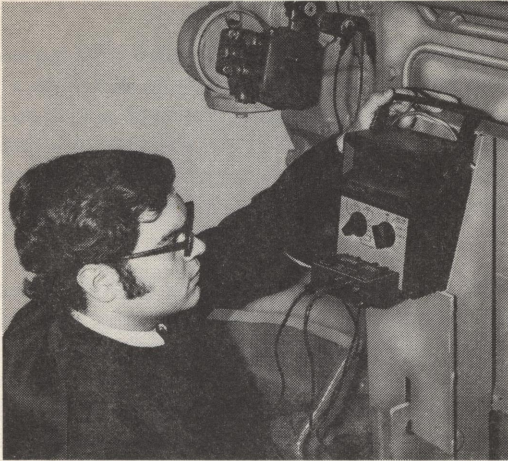


FIG. XI-18. MEASURING ENGINE SPEED AT TACHOMETER DRIVE FITTING ON GOVERNOR DRIVE GEAR BOX.

compressor running unloaded, take voltage and current readings and plot the point on the appropriate load curve, Figs. XI-24 thru XI-32.

CAUTION: Do not hold high current loads any longer than necessary to protect the equipment against possible high temperature damage developed by the high current.

2. Gradually advance the Throttle handle to Notch 8, while watching the ammeter to be sure the limit shown on the curve is not overrun. Read the meters

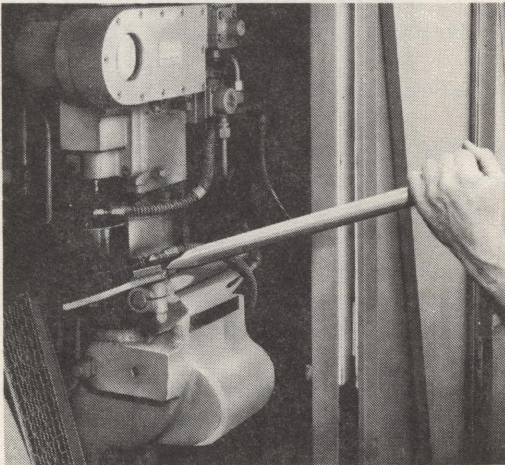


FIG. XI-19. INCREASING ENGINE SPEED WITH SPECIAL OVERSPEED TEST LEVER TOOL.

and plot the point on the nearly vertical right end of the curve. The point should fall between the curve limits, in line with the point plotted for Notch 4 and the origin, or left corner, of the curve.

3. If an adjustment is required, adjust the rheostat to give a current value which will fall within the limits of the curve and on the resistance line being used. This line should cross the curve somewhere below the lower right "corner point." Check that the LCP (Load Control Potentiometer) brush arm on the engine control governor is operating at the 5:30 o'clock or "Max. Field" position.
4. Return the Throttle handle to the IDLE position.
5. If the rheostat was adjusted, repeat the open-circuit voltage check to determine it is still within the curve limits, since any adjustment may have changed the envelope or size of the whole curve.

Output Curve Check

NOTE: The curved portion of the Load Curves is the constant horsepower section, and the resistance steps on the loading device must be selected to get points in this section.

Select a resistance step on the loading device, move the Throttle handle to Notch 8, plot the point on the appropriate curve then return the handle to IDLE.

Make another selection of resistance on the loading unit and repeat. Thus, a number of points can be checked in this manner, however, only at the resistance values available on the loading device being used.

CAUTION: Do not hold high-current loads any longer than necessary to protect the equipment against possible damage due to high temperatures developed by the high current.

Refer to FL138 excitation panel instructions for additional information on the proper operation of the LCP (Load Control Potentiometer) in the engine control governor. With near standard test conditions the indicator should not go to less than about 4:30 o'clock (from the "Max. Field" position of 5:30) at any time during the horsepower curve check. If it does go to a lower value, refer to the excitation panel instructions for possible causes and corrections.

The curves, Figs. XI-24 thru XI-32, are based on standard 1-2-3-4-5-6-7-8 engine speeds, with Power Matching disconnected. Also the Steps 1-10 resistance lines are for an

EM99 Loading Unit. Other resistances can be used and values plotted on same curves if found necessary to load on some other device. The EM99 step resistances are given in heading of table for each curve, Figs. XI-24 thru XI-32.

SETTING POWER MATCHING

Description

The Power Match feature is required to protect the traction motors of some locomotives, when working in multiple with older units, to prevent damage to or reduce the life of the motors. This feature works during the first step of transition, being bypassed in any others. Thus only high current or slow speed operation of the locomotive is modified.

If all locomotives dispatched in a consist were of the same model, with same gearing and wheel size or have corresponding short-time ratings, Power Matching would not be necessary. However a consist of locomotives is seldom made up of units with similar ratings, whether of the same manufacturer or of different manufacturers.

Any locomotive operating continuously or for long periods of time at a speed lower than its CONTINUOUS RATING, needs this feature as a protective device. Unless the high horsepower locomotive is the lead unit (the one the operating crew is riding) the crew is unaware of traction motor overloading until it slips or smokes excessively. The crew may be watching a loadmeter with much less restrictive time limits.

NOTE: *Normally locomotives with this protection are derated, with a corresponding loss in available horsepower for train starting and slow speed operation. This applies even when operating alone or with others of the same model. The settings for Power Matching are variable. Thus it is important to have it readjusted whenever the type of locomotives causing the problem and determining the setting are transferred to another territory or retired from service.*

When properly set, Power Matching will protect the traction motors from overheating their insulation and thus shortening their useful life. It reduces the current thru the motors to be compatible with the ratings of the motors on the other locomotives operating in multiple with it.

NOTE: *Do not confuse Power Matching with Power Limit. This is a Toggle switch on the operator's console with Notch 7 and NORMAL positions. It is provided for use on the lead locomotive to condition the rail for the trailing locomotives, permitting a higher average of tractive effort over the grades and thus a higher speed than otherwise possible.*

Power Matching is also known as Performance Control as applied on competitors locomotives.

A periodic survey should be conducted of all locomotives working together in a given territory to determine if there has been a change in the restriction on all pooled power. It could allow the amount of Power Matching to be adjusted to utilize more of the available power (or eliminate Power Matching altogether) on each locomotive, at the lower speeds.

As an example of the application of Power Matching, assume Locomotive No. 1 is an older unit with a continuous rating Point C1 on Speed-Tractive Effort Curve, Fig. XI-20-A. A second, higher horsepower Locomotive No. 2 with a different continuous rating point, C2, is shown on the same curve. Since the two locomotives are coupled together they must pull the train at the same speed and without Power Matching No. 2 would normally operate at Point A when Locomotive No. 1 is at continuous rating. This is at a current exceeding its continuous current rating. When transposed to the Alternator-Rectifier Characteristic Curves, Fig. XI-20-B, the Points A, C1 and C2 might be located as in Fig. XI-20-C.

Point B is determined at the same speed as C1 but the same tractive effort (same current for like motors and gearings) as C2. It transposes as a point on a reduced horsepower output curve of Fig. XI-20-D, say 3000 hp. During train acceleration the Power Matching on Locomotive No. 2 would then cut in at D, follow the reduced output curve to B, then transfer back to the full horsepower curve at C2, continuing along that curve. Remember this reduction is not made after transition when coming back along the full horsepower curve the next time.

Point C2 is referred to as the KNEE and line B-D as the LEVEL for setting Power Matching, Fig. XI-22.

Adjusting Power Matching

The CHEC excitation panel, FL138, has two adjustments for Power Matching located under the high voltage cover at the right end of the panel along with six other panel-mounted 20-turn potentiometers. The lower two potentiometers, Numbers 7 and 8, set the KNEE and the LEVEL for Power Matching. All adjustments are done with a very small insulated screwdriver, Fig. XI-21.

See Fig. XI-22 for details on adjustments. CW reduces both settings while CCW increases them.

There are no standard settings for Power Matching. Each railroad determines the proper setting for each type locomotive in each territory. Be sure to follow the latest railroad instruction when checking or changing the setting.

FIG. XI-20, E-25395

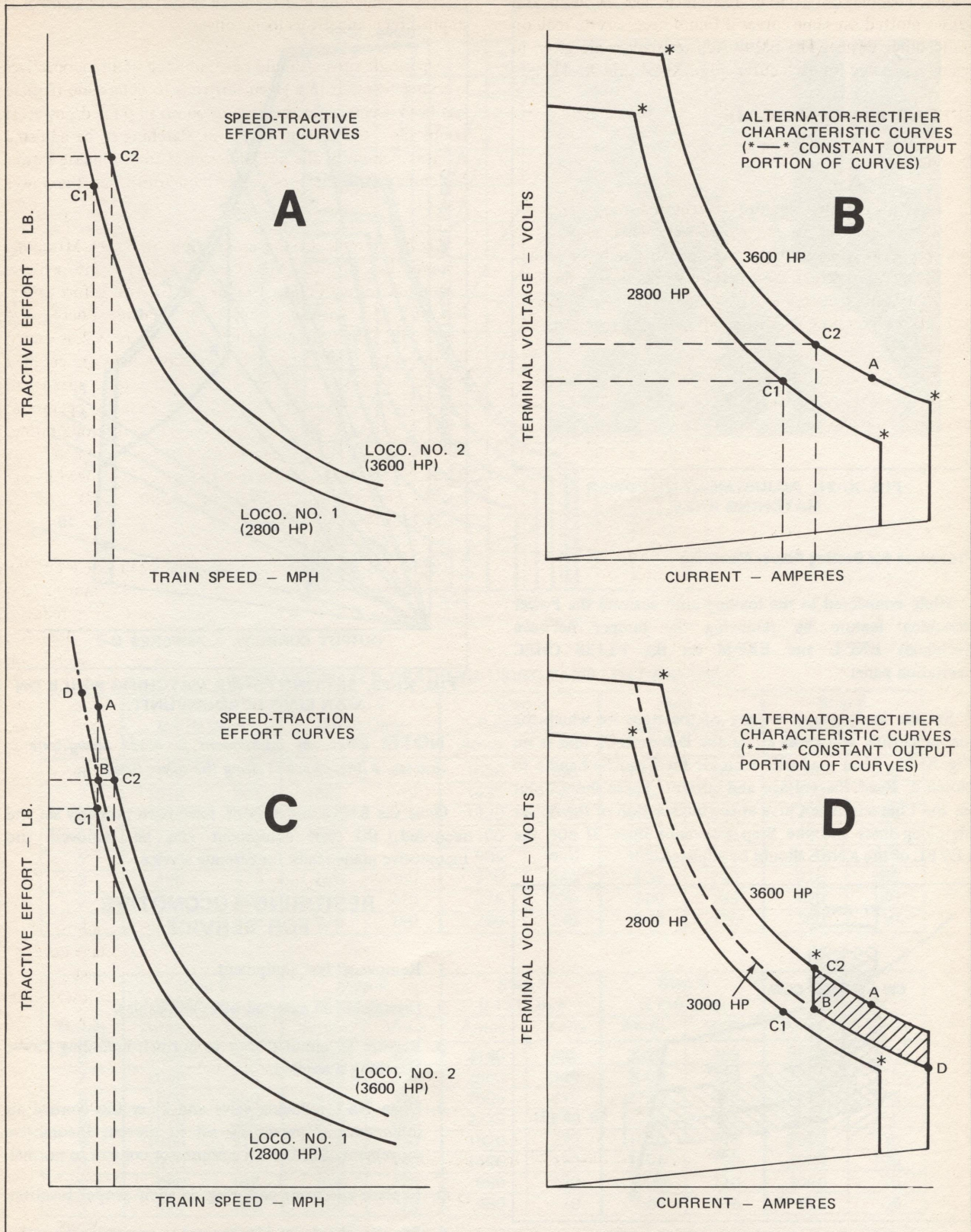


FIG. XI-20. DETERMINING SETTINGS FOR POWER MATCHING.

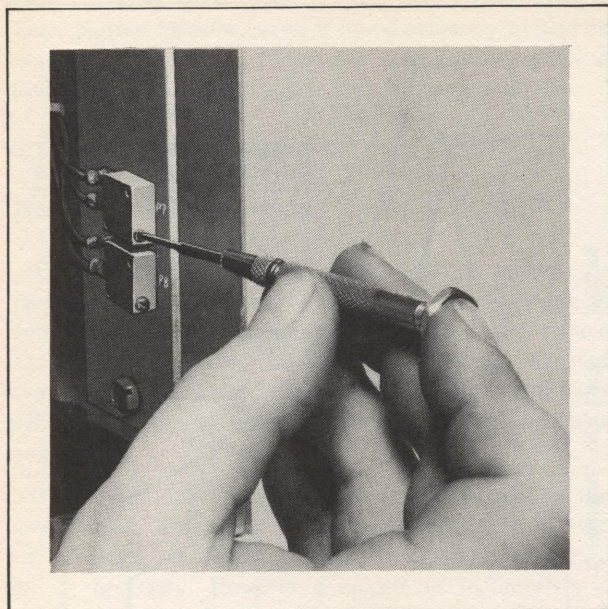


FIG. XI-21. ADJUSTMENT OF POWER MATCHING KNEE.

Procedure for Setting Power Matching

While connected to the loading unit, activate the Power Matching feature by removing the jumper between Terminals EXP-L and EXP-M on the FL138 CHEC excitation panel.

Set the loading unit on any of the steps for which the resistance line will cross either the D-B or B-C2 line as on Fig. XI-23. Then gradually increase the Throttle handle to Notch 8. Read the voltage and current. These should plot on the Characteristic Curve at the intersection of the Power Matching lines and the Step resistance lines. If not, the LEVEL or the KNEE should be adjusted.

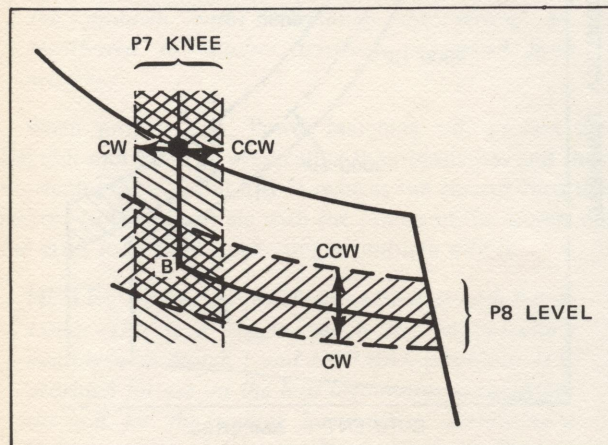


FIG. XI-22. P7 KNEE AND P8 LEVEL ADJUSTMENT DETAILS.

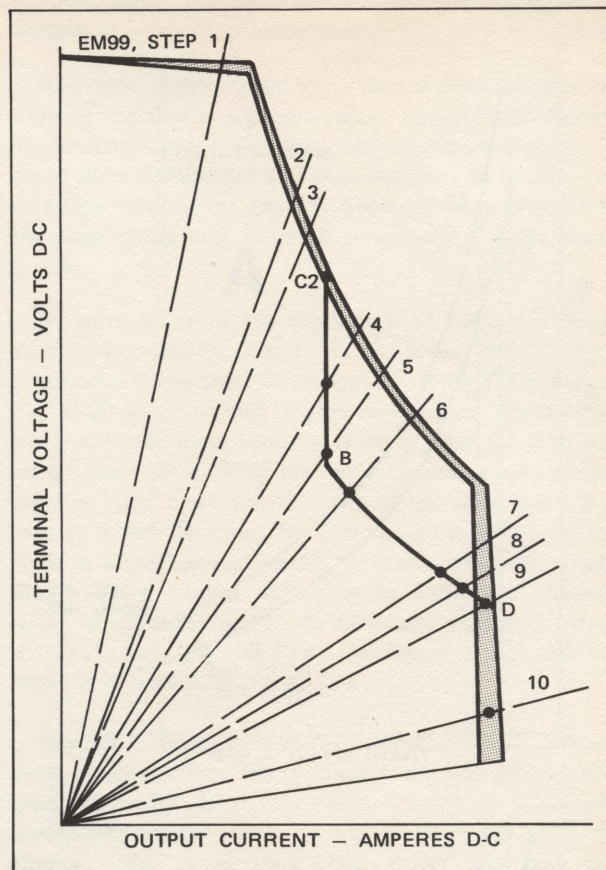


FIG. XI-23. SETTING POWER MATCHING WHILE ON AN EM99 LOADING UNIT.

NOTE: When an adjustment is made along one resistance line, check it along the other lines.

Once the KNEE and LEVEL have been properly set and recorded, the test equipment can be removed and locomotive made ready for revenue service.

RESTORING LOCOMOTIVE FOR SERVICE

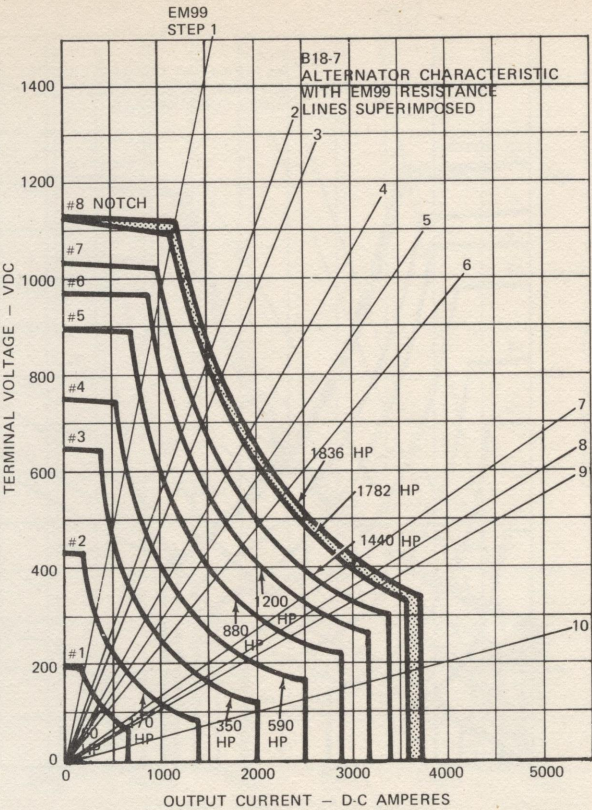
1. Remove all test equipment.
2. Disconnect all external wires and cables.
3. Restore all circuits back to normal, including Power Matching if applied.
4. Open NS-1 reducing valve and close the control air drain cock if previously set to prevent locomotive movement. Restore air compressor control to normal.
5. Replace all covers and plugs in their proper location.
6. Remove chocks or blocks used to prevent locomotive movement.

FIG. XI-21, E-25396

FIG. XI-22, E-25397

FIG. XI-23, E-25394

FIG. XI-24, E-25364

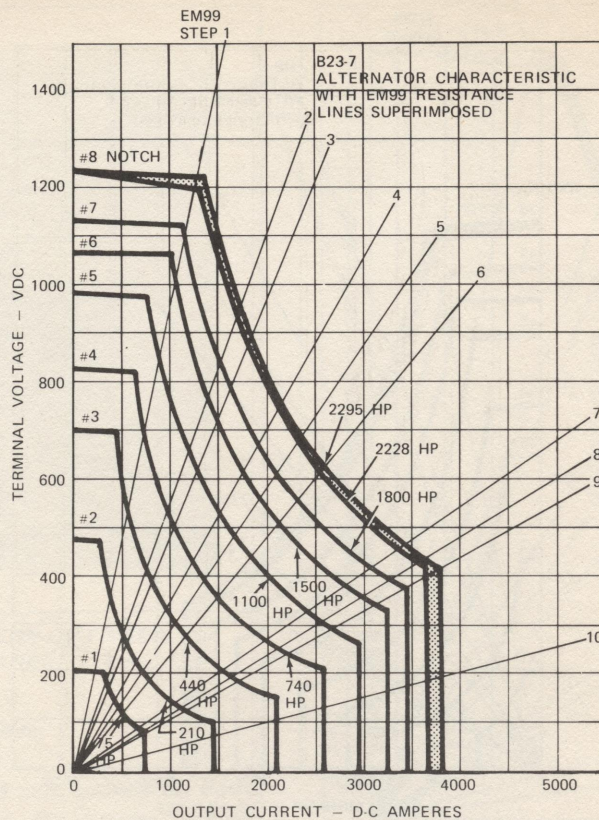


AVERAGE METER READINGS USING EM99 LOADING UNIT

Notch	Step 1 0.970 Ohm		Step 2 0.546 Ohm		Step 3 0.485 Ohm		Step 4 0.347 Ohm		Step 5 0.290 Ohm	
	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts
8	1145	1110	1540	840	1620	785	1915	665	2085	605
7	1015	985	1365	745	1435	695	1700	590	1860	540
6	930	900	1245	680	1320	640	1555	540	1705	495
5	785	760	1055	575	1105	535	1310	455	1430	415
4	640	620	860	470	905	440	1080	375	1170	340
3	490	475	660	360	700	340	835	290	915	265
2	310	300	440	240	475	230	560	195	620	180
1	195	190	275	150	290	140	345	120	380	110

Notch	Step 6 0.242 Ohm		Step 7 0.134 Ohm		Step 8 0.121 Ohm		Step 9 0.110 Ohm		Step 10 0.052 Ohm	
	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts
8	2295	555	3020	405	3180	385	3320	365	3655	190
7	2045	495	2725	365	2850	345	3000	330	3365	175
6	1860	450	2465	330	2605	315	2730	300	3175	165
5	1570	380	2125	285	2235	270	2320	255	2885	150
4	1300	315	1715	230	1820	220	1910	210	2500	130
3	1010	245	1345	180	1405	170	1455	160	2020	105
2	680	165	935	125	990	120	1000	110	1440	75
1	415	100	560	75	580	70	590	65	675	35

FIG. XI-24. LOADING B18-7 ON EM99 LOADING UNIT.



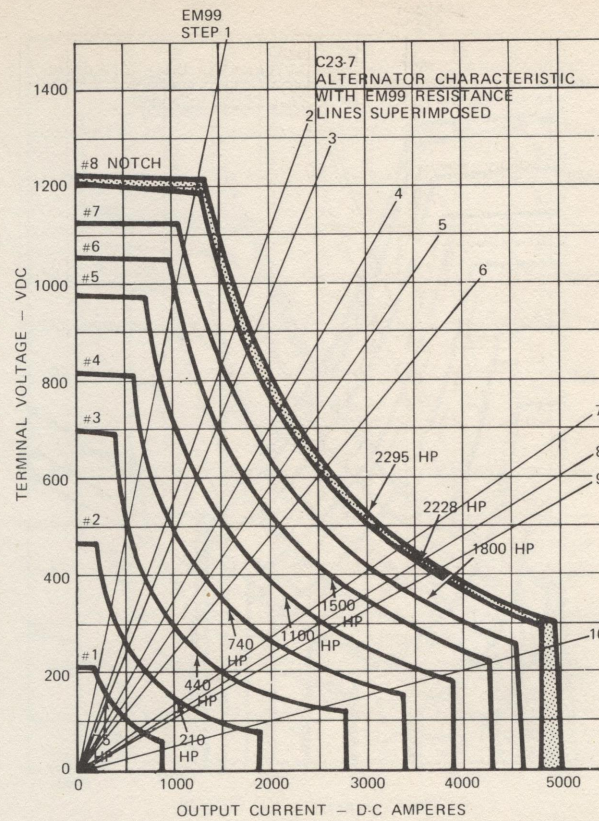
AVERAGE METER READINGS USING EM99 LOADING UNIT

Notch	Step 1 0.970 Ohm		Step 2 0.546 Ohm		Step 3 0.485 Ohm		Step 4 0.347 Ohm		Step 5 0.290 Ohm	
	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts
8	1250	1210	1720	940	1805	875	2145	745	2330	675
7	1130	1095	1530	835	1610	780	1915	665	2090	605
6	1050	1015	1400	765	1475	715	1745	605	1895	550
5	875	850	1180	645	1250	605	1500	520	1620	470
4	715	695	970	530	1020	495	1210	420	1330	385
3	540	520	725	395	765	370	920	320	1015	295
2	360	350	495	270	525	255	635	220	690	200
1	210	205	310	170	330	160	390	135	430	125

Notch	Step 6 0.242 Ohm		Step 7 0.134 Ohm		Step 8 0.121 Ohm		Step 9 0.110 Ohm		Step 10 0.052 Ohm	
	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts
8	2560	620	3360	450	3510	425	3635	400	3655	190
7	2295	555	3060	410	3225	390	3365	370	3365	175
6	2085	505	2800	375	2935	355	3090	340	3175	165
5	1795	435	2390	320	2520	305	2635	290	2885	150
4	1465	355	1980	265	2065	250	2180	240	2500	130
3	1115	270	1490	200	1570	190	1680	185	2020	105
2	765	185	1045	140	1075	130	1135	125	1345	70
1	475	115	635	85	660	80	680	75	675	35

FIG. XI-25. LOADING B23-7 ON EM99 LOADING UNIT.

FIG. XI-26, E-25366

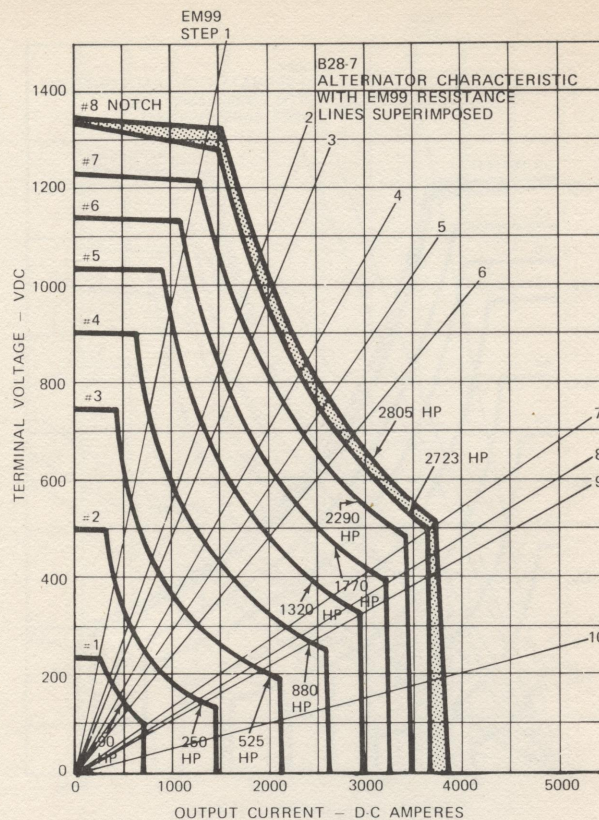


AVERAGE METER READINGS USING EM99 LOADING UNIT

Notch	Step 1 0.970 Ohm		Step 2 0.546 Ohm		Step 3 0.485 Ohm		Step 4 0.347 Ohm		Step 5 0.290 Ohm	
	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts
8	1250	1210	1720	940	1815	880	2145	745	2345	680
7	1140	1105	1520	830	1610	780	1915	665	2105	610
6	1050	1020	1400	765	1475	715	1745	605	1895	550
5	875	850	1180	645	1250	605	1485	515	1640	475
4	710	690	960	525	1020	495	1225	425	1345	390
3	545	530	725	395	765	370	920	320	1015	295
2	360	350	520	285	525	255	635	220	705	205
1	210	205	310	170	330	160	405	140	395	115

Notch	Step 6 0.242 Ohm		Step 7 0.134 Ohm		Step 8 0.121 Ohm		Step 9 0.110 Ohm		Step 10 0.052 Ohm	
	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts
8	2560	620	3395	455	3555	430	3730	410	4810	250
7	2295	555	3060	410	3225	390	3365	370	4425	230
6	2085	505	2875	385	2935	355	3045	335	4135	215
5	1795	435	2425	325	2520	305	2635	290	3655	190
4	1465	355	2015	270	2065	250	2180	240	3075	160
3	1115	270	1495	200	1570	190	1680	185	2405	125
2	785	190	1045	140	1075	130	1180	130	1635	85
1	475	115	635	85	660	80	680	75	865	45

FIG. XI-26. LOADING C23-7 ON EM99 LOADING UNIT.



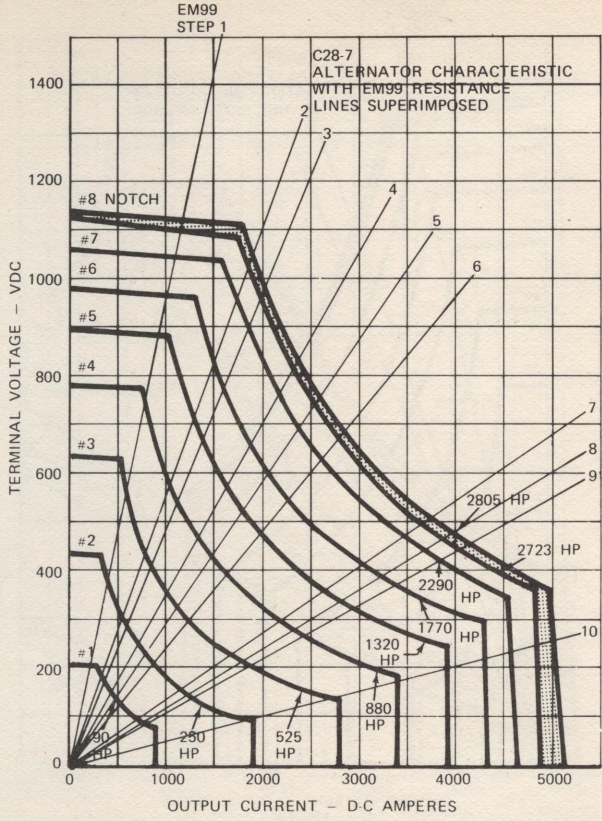
AVERAGE METER READINGS USING EM99 LOADING UNIT

Notch	Step 1 0.970 Ohm		Step 2 0.546 Ohm		Step 3 0.485 Ohm		Step 4 0.347 Ohm		Step 5 0.290 Ohm	
	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts
8	1340	1300	1925	1050	1990	965	2375	825	2585	750
7	1250	1215	1730	945	1825	885	2160	750	2380	690
6	1140	1105	1500	820	1590	770	1875	650	2050	595
5	985	955	1320	720	1390	675	1645	570	1795	520
4	770	745	860	570	1105	535	1325	460	1450	420
3	580	565	795	435	845	410	1010	350	1120	325
2	410	400	550	300	600	290	705	245	775	225
1	225	220	350	190	370	180	445	155	485	140

Notch	Step 6 0.242 Ohm		Step 7 0.134 Ohm		Step 8 0.121 Ohm		Step 9 0.110 Ohm		Step 10 0.052 Ohm	
	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts
8	2810	680	3655	490	3635	440	3635	400	3655	190
7	2605	630	3395	455	3390	410	3365	370	3365	175
6	2250	545	3060	410	3180	385	3180	350	3270	170
5	1985	480	2650	355	2770	335	2865	315	2885	150
4	1610	390	2165	290	2270	275	2365	260	2500	130
3	1240	300	1715	230	1820	220	1865	205	2115	110
2	850	205	1195	160	1240	150	1090	120	1345	70
1	540	130	670	90	660	80	635	70	770	40

FIG. XI-27. LOADING B28-7 ON EM99 LOADING UNIT.

FIG. XI-28, E-25368

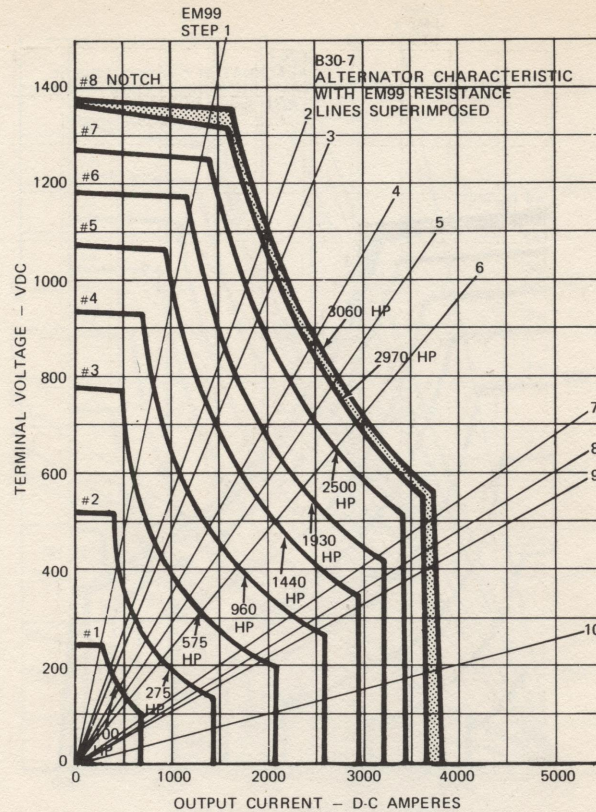


AVERAGE METER READINGS USING EM99 LOADING UNIT

Notch	Step 1 0.970 Ohm		Step 2 0.546 Ohm		Step 3 0.485 Ohm		Step 4 0.347 Ohm		Step 5 0.290 Ohm	
	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts
8	1145	1110	1905	1040	2010	975	2375	825	2585	750
7	1080	1050	1740	950	1835	890	2160	750	2380	690
6	1000	970	1520	830	1600	775	1885	655	2070	600
5	910	885	1320	720	1380	670	1640	570	1795	520
4	785	760	1060	580	1125	545	1340	465	1465	425
3	580	565	795	435	845	410	1010	350	1120	325
2	400	390	570	310	600	290	720	250	795	230
1	215	210	340	185	350	170	430	150	465	135

Notch	Step 6 0.242 Ohm		Step 7 0.134 Ohm		Step 8 0.121 Ohm		Step 9 0.110 Ohm		Step 10 0.052 Ohm	
	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts
8	2830	685	3730	500	3925	475	4090	450	5000	260
7	2605	630	3505	470	3680	445	3820	420	4615	240
6	2250	545	3060	410	3180	385	3365	370	4325	225
5	1960	475	2725	365	2770	335	2910	320	3940	205
4	1610	390	2165	290	2275	275	2410	265	3460	180
3	1240	300	1680	225	1775	215	1820	200	2690	140
2	870	210	1120	150	1240	150	1275	140	1925	100
1	515	125	710	95	745	90	775	85	962	50

FIG. XI-28. LOADING C28-7 ON EM99 LOADING UNIT.



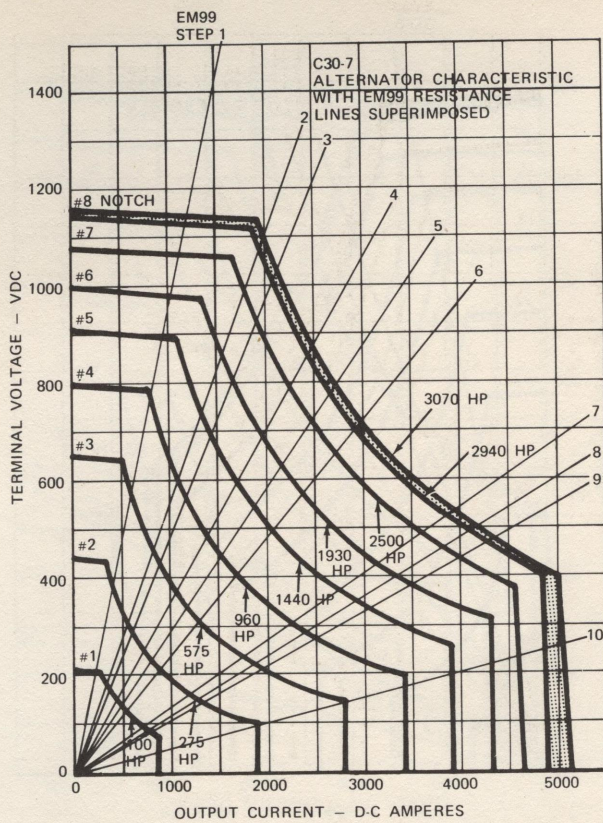
AVERAGE METER READINGS USING EM99 LOADING UNIT

Notch	Step 1 0.970 Ohm		Step 2 0.546 Ohm		Step 3 0.485 Ohm		Step 4 0.347 Ohm		Step 5 0.290 Ohm	
	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts
8	1380	1340	2000	1090	2105	1020	2480	860	2705	785
7	1290	1250	1815	990	1910	925	2260	785	2465	715
6	1185	1150	1575	860	1650	800	1960	680	2140	620
5	1015	985	1365	745	1445	700	1700	590	1860	540
4	815	790	1275	695	1155	560	1385	480	1515	440
3	615	595	835	455	885	430	1065	370	1170	340
2	440	425	575	315	610	295	720	250	895	260
1	260	250	365	200	380	185	460	160	500	145

Notch	Step 6 0.242 Ohm		Step 7 0.134 Ohm		Step 8 0.121 Ohm		Step 9 0.110 Ohm		Step 10 0.052 Ohm	
	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts
8	2935	710	3695	495	3635	440	3680	405	3655	190
7	2705	655	3435	460	3390	410	3365	370	3365	175
6	2355	570	3170	425	3180	385	3180	350	3175	165
5	2045	495	2760	370	2890	350	2910	320	2885	150
4	1675	405	2275	305	2395	290	2500	275	2595	135
3	1280	310	1790	240	1860	225	1955	215	2115	110
2	890	215	1195	160	1280	155	1365	150	1440	75
1	560	135	670	90	660	80	635	70	675	35

FIG. XI-29. LOADING B30-7 ON EM99 LOADING UNIT.

FIG. XI-30, E-25370

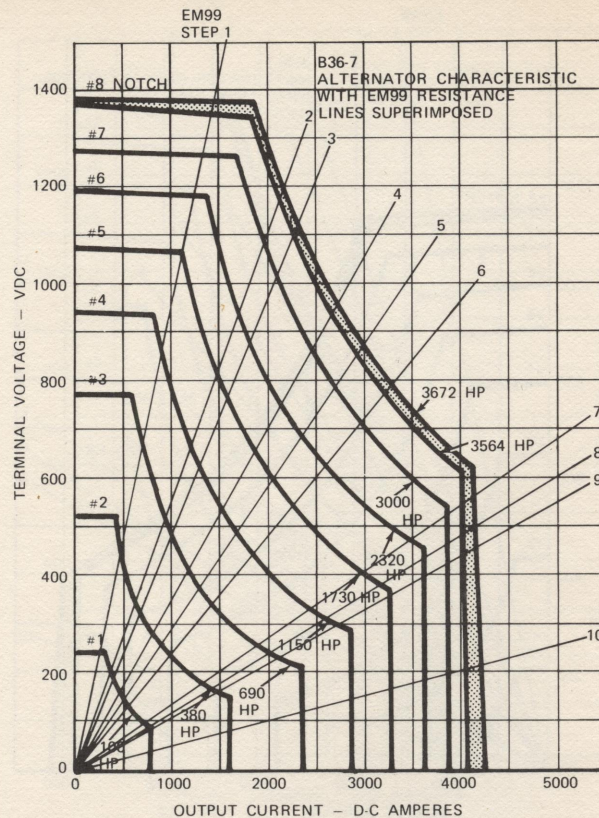


AVERAGE METER READINGS USING EM99 LOADING UNIT

Notch	Step 1 0.970 Ohm		Step 2 0.546 Ohm		Step 3 0.485 Ohm		Step 4 0.347 Ohm		Step 5 0.290 Ohm	
	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts
8	1170	1135	1985	1085	2080	1010	2480	860	2690	780
7	1075	1045	1575	860	1650	800	1960	680	2140	620
6	945	915	1265	690	1320	640	1570	545	1705	495
5	760	740	1015	555	1070	520	1285	445	1380	400
4	590	575	795	435	845	410	1010	350	1105	320
3	485	470	650	355	690	335	820	285	895	260
2	400	390	530	290	555	270	665	230	725	210
1	175	170	310	170	350	170	445	155	480	140

Notch	Step 6 0.242 Ohm		Step 7 0.134 Ohm		Step 8 0.121 Ohm		Step 9 0.110 Ohm		Step 10 0.052 Ohm	
	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts
8	2955	715	3920	525	4050	490	4270	470	4810	250
7	2355	570	3170	425	3305	400	3545	390	4515	235
6	1880	455	2535	340	2645	320	2775	305	4040	210
5	1530	370	2050	275	2150	260	2225	245	3270	170
4	1200	290	1640	220	1695	205	1775	195	2595	135
3	990	240	1345	180	1365	165	1455	160	2115	110
2	805	195	1080	145	1115	135	1180	130	1730	90
1	540	130	745	100	745	90	775	85	865	45

FIG. XI-30. LOADING C30-7 ON EM99 LOADING UNIT.



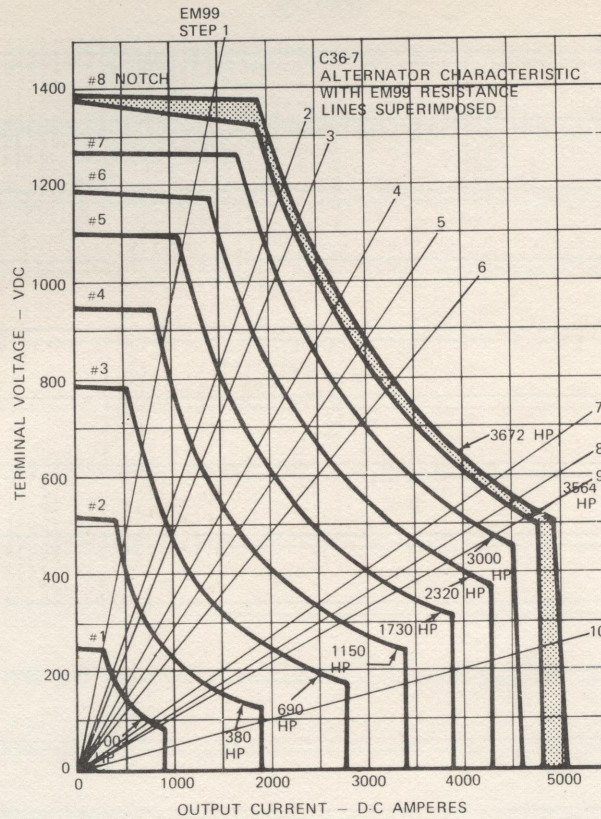
AVERAGE METER READINGS USING EM99 LOADING UNIT

Notch	Step 1 0.970 Ohm		Step 2 0.546 Ohm		Step 3 0.485 Ohm		Step 4 0.347 Ohm		Step 5 0.290 Ohm	
	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts
8	1410	1370	2180	1190	2310	1120	2725	945	2965	860
7	1315	1275	1990	1085	2095	1015	2480	860	2690	780
6	1225	1190	1730	945	1825	885	2160	750	2380	690
5	1110	1075	1490	815	1580	765	1875	650	2050	595
4	895	870	1210	660	1280	620	1525	530	1670	485
3	690	670	935	510	990	480	1180	410	1275	370
2	470	455	630	345	670	325	790	275	860	250
1	260	250	365	200	380	185	460	160	485	140

Notch	Step 6 0.242 Ohm		Step 7 0.134 Ohm		Step 8 0.121 Ohm		Step 9 0.110 Ohm		Step 10 0.052 Ohm	
	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts
8	3265	790	4105	550	4010	485	4000	440	4040	210
7	2955	715	3880	520	3800	460	3820	420	3845	200
6	2605	630	3510	470	3555	430	3545	390	3560	185
5	2250	545	3020	405	3140	380	3180	350	3175	165
4	1840	445	2465	330	2560	310	2725	300	2790	145
3	1405	340	1940	260	1985	240	2090	230	2305	120
2	950	230	1345	180	1365	165	1455	160	1540	80
1	535	130	745	100	745	90	725	80	770	40

FIG. XI-31. LOADING B36-7 ON EM99 LOADING UNIT.

FIG. XI-32, E-25372



AVERAGE METER READINGS USING EM99 LOADING UNIT

Notch	Step 1 0.970 Ohm		Step 2 0.546 Ohm		Step 3 0.485 Ohm		Step 4 0.347 Ohm		Step 5 0.290 Ohm	
	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts
8	1390	1350	2190	1195	2310	1120	2740	950	2960	860
7	1300	1260	1980	1085	2090	1015	2480	860	2700	780
6	1215	1180	1720	940	1820	880	2160	750	2360	685
5	1100	1080	1480	810	1580	760	1870	650	2050	595
4	885	860	1200	660	1280	620	1530	530	1670	485
3	680	660	930	510	1000	485	1170	405	1290	375
2	465	450	610	335	660	320	780	270	860	250
1	260	250	350	190	370	180	450	155	500	145

Notch	Step 6 0.242 Ohm		Step 7 0.134 Ohm		Step 8 0.121 Ohm		Step 9 0.110 Ohm		Step 10 0.052 Ohm	
	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts	Amps.	Volts
8	3230	780	4300	575	4540	550	4730	520	4880	255
7	2950	715	3950	530	4140	500	4350	480	4570	238
6	2590	625	3500	470	3660	445	3870	425	4300	220
5	2240	540	3000	400	3160	380	3330	365	3900	200
4	1820	440	2470	330	2600	315	2740	300	3400	175
3	1400	340	1900	255	2020	245	2150	235	2800	145
2	950	230	1300	175	1360	165	1430	158	1900	98
1	540	130	740	100	780	95	820	90	900	46

FIG. XI-32. LOADING C36-7 ON EM99 LOADING UNIT.